

(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開2001-228465

(P2001-228465A)

(43) 公開日 平成13年8月24日 (2001.8.24)

(51) Int. Cl. ⁷	識別記号	F I	ターミナル* (参考)
G 0 2 F	1/1333	5 0 0	2 H 0 8 8
	1/13	1 0 1	2 H 0 8 9
		5 0 5	2 H 0 9 0
	1/1339	5 0 5	2 H 0 9 2
	1/1368	G 0 9 F 9/00	5 C 0 5 8

審査請求 未請求 請求項の数13 O L (全 12 頁) 最終頁に続く

(21) 出願番号 特願2000-36845(P2000-36845)

(22) 出願日 平成12年2月15日 (2000.2.15)

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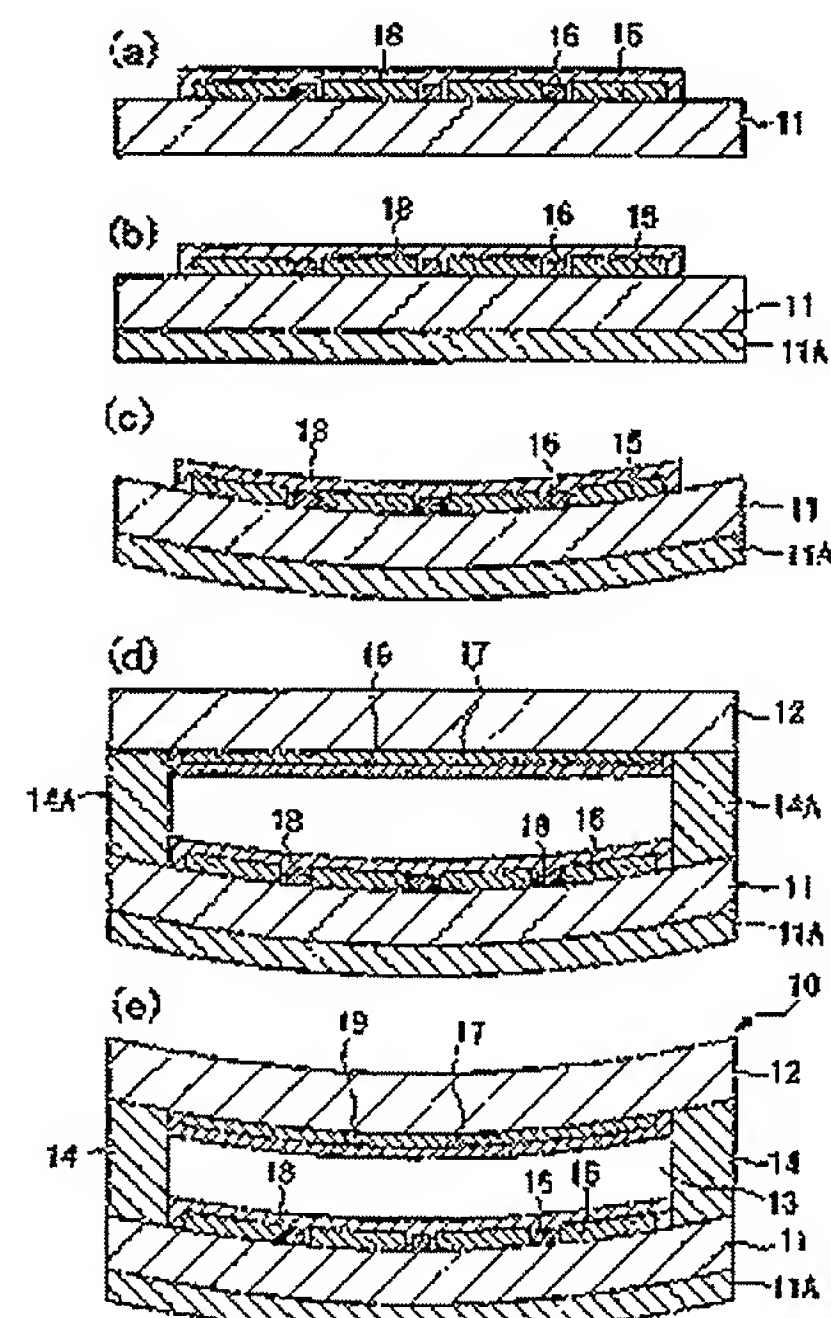
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(54) 【発明の名称】 液晶装置の製造方法、液晶装置及び電子機器

(57) 【要約】

【課題】 液晶層を挟持する対向する2枚の基板が異なる材料からなる場合に、液晶セルのセル厚の均一化を可能にする液晶表示装置の製造方法を提供する。

【解決手段】 液晶層13を挟持する基板11と対向基板12として、異なる基板が用いられており、対向基板12の熱膨張係数が基板11の熱膨張係数より小さいになっている。内表面上に、画素電極15などを形成した基板11の外表面上に、接着剤を介して、基板11とは異なる所定の熱膨張係数を有する平板部材11Aを貼着する。基板11と平板部材11Aを所定の温度以上に加熱した後、常温に戻すことにより、基板11と対向基板11Aのうち、熱膨張係数の大きい方が熱膨張係数の小さい方よりも昇温とともに大きく膨張し、降温とともに大きく収縮するので、基板11を所定の形状に湾曲させることができる。その後、基板11と対向基板12とをシール材14を介して所定の間隔で貼着する。



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【特許請求の範囲】

【請求項 1】 周縁部においてシール材を介して所定の間隔で貼着された、液晶層を挟持する対向する 2 枚の基板が異なる材料からなる液晶装置の製造方法において、前記対向する 2 枚の基板のうち、熱膨張係数の大きい基板の外表面上に、接着剤を介して、該基板とは異なる所定の熱膨張係数を有する平板部材を貼着し所定の温度以上に加熱した後、常温に戻すことにより、該基板と該平板部材とを所定の形状に湾曲させた後、該基板ともう一方の前記基板とを前記シール材を介して貼着することを特徴とする液晶装置の製造方法。

【請求項 2】 請求項 1 記載の液晶装置の製造方法において、前記平板部材は前記基板の熱膨張係数より小さい熱膨張係数を有するものであり、前記基板と前記平板部材とを該平板部材側が凸になるように湾曲させたことを特徴とする液晶装置の製造方法。

【請求項 3】 請求項 2 記載の液晶装置の製造方法において、前記基板と前記平板部材の熱膨張係数の差が、前記もう一方の基板と前記基板の熱膨張係数の差に等しいことを特徴とする液晶装置の製造方法。

【請求項 4】 請求項 1 記載の液晶装置の製造方法において、前記平板部材は前記基板の熱膨張係数より大きい熱膨張係数を有するものであり、前記基板と前記平板部材とを該基板側が凸になるように湾曲させたことを特徴とする液晶装置の製造方法。

【請求項 5】 請求項 4 記載の液晶装置の製造方法において、前記基板と前記平板部材の熱膨張係数の差が、前記もう一方の基板と前記基板の熱膨張係数の差に等しいことを特徴とする液晶装置の製造方法。

【請求項 6】 請求項 1 から請求項 5 までのいずれか 1 項記載の液晶装置の製造方法において、前記接着剤が前記シール材と同一の材料からなることを特徴とする液晶装置の製造方法。

【請求項 7】 周縁部においてシール材を介して所定の間隔で貼着された、液晶層を挟持する対向する 2 枚の基板が異なる材料からなる液晶装置において、前記対向する 2 枚の基板のうち、熱膨張係数の大きい基板の外表面上に、接着剤を介して、該基板とは異なる所定の熱膨張係数を有する平板部材が貼着され、該基板、該平板部材、もう一方の前記基板が所定の形状に湾曲されたことを特徴とする液晶装置。

【請求項 8】 請求項 7 記載の液晶装置において、前記平板部材は前記基板の熱膨張係数より小さい熱膨張係数を有するものであり、前記基板と前記平板部材とは該平板部材側が凸になるように湾曲され、前記もう一方の基板は内表面側が凸になるように湾曲されたことを特徴とする液晶装置。

【請求項 9】 請求項 8 記載の液晶装置において、前記基板と前記平板部材の熱膨張係数の差が、前記もう一方の基板と前記基板の熱膨張係数の差に等しいことを特徴

とする液晶装置。

【請求項 10】 請求項 7 記載の液晶装置において、前記平板部材は前記基板の熱膨張係数より大きい熱膨張係数を有するものであり、前記基板と前記平板部材とは該基板側が凸になるように湾曲され、前記もう一方の基板は外表面側が凸になるように湾曲されたことを特徴とする液晶装置。

【請求項 11】 請求項 10 記載の液晶装置において、前記基板と前記平板部材の熱膨張係数の差が、前記もう一方の基板と前記基板の熱膨張係数の差に等しいことを特徴とする液晶装置。

【請求項 12】 請求項 7 から請求項 11 までのいずれか 1 項記載の液晶装置において、前記接着剤が前記シール材と同一の材料からなることを特徴とする液晶装置。

【請求項 13】 請求項 7 から請求項 12 までのいずれか 1 項記載の液晶装置を備えることを特徴とする電子機器。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、液晶装置の製造方法、液晶装置及び電子機器に係り、特に液晶層を挟持する対向する 2 枚の基板が異なる材料からなる液晶装置の製造方法、該製造方法により製造される液晶装置、該液晶装置を備える電子機器に関する。

【0002】

【従来の技術】液晶ディスプレイとして、携帯電話や携帯型情報処理装置などに搭載される直視型液晶ディスプレイと、プロジェクタなどの投射型液晶ディスプレイとが知られている。

【0003】図 7 に、直視型液晶ディスプレイに用いられる一般の液晶表示装置 100 の概略断面図を示し、この液晶表示装置の構造を説明する。

【0004】図 7 に示すように、基板（下側基板）101 と対向基板（上側基板）102 とがそれぞれの周縁部においてシール材 104 を介して所定間隔で貼着され、基板 101、対向基板 102 間に液晶層 103 が封入されている。基板 101 と対向基板 102 の内面上にはそれぞれ所定のパターンで透明電極 105、106 が形成され、透明電極 105、106 上には配向膜 107、108 が形成されている。

【0005】基板 101、対向基板 102 の外側には位相差板、偏光板が設置されるが、図示では省略している。

【0006】液晶表示装置 100 において、基板 101 及び対向基板 102 の間隔（液晶セルのセル厚）を一定に保つために、二酸化珪素、ポリスチレンなどからなる多数の球状のスペーサー 109 が基板 101、対向基板 102 間に配置されている。

【0007】次に、図 8 に、投射型液晶ディスプレイに用いられる一般の液晶表示装置 200 の概略断面図を示

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し、この液晶表示装置の構造を説明する。図8において、液晶表示装置100と同じ構成要素には同じ参照番号を付し、説明は省略する。

【0008】液晶表示装置200においては、液晶パネルを拡大投影して表示を行うため、基板101、対向基板102間にスペーサーを配置した場合に、スペーサーも拡大して表示されるので、その部分に光漏れが生じ、表示品質を低下させるという問題がある。そのため、液晶表示装置200においては、図8に示すように、基板101、対向基板102間にスペーサーを配置することができない。

【0009】

【発明が解決しようとする課題】上記の液晶表示装置100、200で示したような一般の液晶表示装置において、基板101、対向基板102として、通常は同一の基板が用いられるが、異なる基板が用いられる場合がある。

【0010】基板101、対向基板102として、異なる基板が用いられる例として、図9に投射型ディスプレイに用いられる反射型液晶表示装置300を示し、この液晶表示装置の構造を説明する。図9において、液晶表示装置200と同じ構成要素には同じ参照番号を付し、説明は省略する。

【0011】基板101上には、光を反射するアルミニウムなどからなる反射電極305がマトリクス状に多数形成されていて、各反射電極305を駆動するためのスイッチング素子が設けられている。反射電極305及びスイッチング素子上には配向膜107が形成されている。

【0012】この液晶表示装置300において、対向基板102の外側から液晶パネル内に入射した光は液晶層103を通過し、反射電極305表面で反射され、対向基板102を通過し、液晶パネルの外部へと放出される。

【0013】この液晶表示装置300において、基板101が単結晶シリコンなどの単結晶材料からなり、スイッチング素子がこの単結晶基板上に形成されている時には、ガラス等のアモルファス材料上形成されたスイッチング素子からなる時よりも、基板101上に形成される反射電極305を高速にスイッチングすることができ

る。

【0014】一方、反射電極305で反射された光が対向基板102を通過し、液晶表示装置300の外部へ放出され、表示が行われるため、対向基板102は透明であることが必要となる。そのため、対向基板102として、不透明な単結晶シリコン等を用いることができない。

【0015】したがって、反射型液晶表示装置300を高速度で動作させたい場合や基板101上にトランジスタを形成する場合には、基板101としては単結晶シリコン

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などの単結晶材料からなる基板が用いられ、対向基板102としてはガラスなどの透明材料からなる基板が用いられるので、基板101、対向基板102として、異なる材料からなる基板が用いられる。

【0016】基板101、対向基板102として、異なる基板が用いられる液晶表示装置300においては、液晶表示装置300の製造工程において、シール材104を形成する際に、基板101、対向基板102との間でセル厚ムラを生じるという問題点を有する。

【0017】シール材104は、基板101、対向基板102の周縁部に熱硬化性接着剤又は光硬化性接着剤を塗布し、接着剤を硬化することにより形成される。接着剤の硬化は、熱硬化性接着剤の場合には、通常100～160℃程度に加熱することにより行われ、光硬化性接着剤の場合には、紫外線等を照射することにより行われる。光硬化性接着剤の場合には、加熱は行われないが、紫外線ランプのからの発熱で、80℃程度まで昇温する。

【0018】したがって、シール材104として、熱硬化性接着剤、光硬化性接着剤のいずれを使用する場合においても、液晶セルは100～160℃程度あるいは80℃程度に加熱される。

【0019】その際、基板101、対向基板102として異なる基板が用いられているので、基板101と対向基板102の熱膨張係数が異なり、熱膨張係数の大きい基板が、熱膨張係数の小さい基板と比較して、温度上昇とともに大きく膨張する。さらに、基板の周縁部はシール材104によって固定されているので、膨張した基板に湾曲が生じる。

【0020】例えば、基板101が単結晶シリコン、対向基板102がガラスからなる場合には、単結晶シリコンの方がガラスよりも熱膨張係数が大きいので、対向基板102は、図10(a)に示すように、対向基板102の内表面側が凸になるように湾曲するか、あるいは図10(b)に示すように、対向基板102の外表面側が凸になるように湾曲する。図10(a)、(b)に示す、対向基板102のいずれの湾曲においても、対向基板102が水平な場合からのずれは、対向基板102の中央部でもっとも顕著となっている。例えば、基板101の厚みが $0.6 \times 10^{-3} \text{ m}$ 、対向基板102の厚みが $0.7 \times 10^{-3} \text{ m}$ の場合には、対向基板102の中央部におけるずれの大きさ g は $1 \times 10^{-6} \text{ m}$ 程度となっている。そのため、基板101と対向基板102に挟持される液晶層103の厚み（液晶セルのセル厚）にも $1 \times 10^{-6} \text{ m}$ 程度の分布が生じるという問題点がある。液晶セルのセル厚は $3 \sim 6 \times 10^{-6} \text{ m}$ 程度であるので、このずれは大きいものとなっている。

【0021】以上の問題は、投射型ディスプレイ用の反射型液晶表示装置300に限った問題ではなく、基板101と対向基板102とが異なる基板からなる液晶表示

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装置であればいかなる液晶表示装置においても生じる問題である。

【0022】スペーサー109を配置する一般の直視型液晶ディスプレイ用の液晶表示装置100においては、図10(a)で示した対向基板102の湾曲を防止することはできるが、スペーサー109を配置しても図10(b)で示した対向基板102の湾曲を防止することはできない。

【0023】また、スペーサーを配置しない一般の投射型液晶ディスプレイ用の液晶表示装置200(300を含む)においては、図10(a)、図10(b)で示したいずれの対向基板102の湾曲も防止することができず、問題は顕著となっている。

【0024】ここで、液晶セルのセル厚に分布が生じるときの問題について説明する。液晶セルのセル厚に分布が生じると、液晶表示装置において、表示性能が悪化することが知られている。特にSTN(Super Twisted Nematic)モードの液晶表示装置においては、 $\Delta n \cdot d$ 値(但し、 Δn は液晶の複屈折率、 d はセル厚)の変化により光の透過率が変化することが知られており、 $\Delta n \cdot d$ 値の変化、すなわちセル厚 d の分布が大きいと光透過率すなわち明るさに分布が発生するため、コントラストが低下する。 $\Delta n \cdot d$ 値の変化すなわちセル厚 d の分布が大きいと、STNモードでは位相差板で独特の黄色や青色の着色をなくし、白黒に描像することが行われるが、このとき、光学特性が悪化し、表示に色むらが生じてしまう。また、セル厚 d に分布があると液晶の急峻性が悪化し、コントラストが低下する。このようにセル厚 d に分布が生じることにより、コントラストが悪化し、表示に色むらが発生するため、表示品質が悪化するという問題がある。

【0025】そこで、本発明は上記問題点を解決し、液晶層を挟持する基板、対向基板が異なる材料からなる液晶表示装置の製造方法において、液晶セルのセル厚の均一化を可能にする液晶表示装置の製造方法を提供することを目的とする。また、この製造方法により表示品質の優れた液晶表示装置を提供することを目的とし、さらにこの液晶表示装置を備えることにより、表示品質の優れた電子機器を提供することを目的とする。

【0026】

【課題を解決するための手段】上記課題を解決するために本発明者が検討を行った結果、液晶層を挟持する基板と対向基板のうち、熱膨張係数の大きい基板の外表面上に、接着剤を介して、該基板の熱膨張係数とは異なる所定の熱膨張係数を有する平板部材を貼着し、所定の温度以上に加熱した後、常温に戻すことにより、該基板と該平板部材とを所定の形状に湾曲させることができることを見出し、基板と対向基板とを同一の形状に湾曲させることにより、液晶セルのセル厚を均一化できることを見出した。

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【0027】本発明者が見出した基板の湾曲方法について説明する。

【0028】熱膨張係数の大きい基板の外表面上に、接着剤を介して、該基板の熱膨張係数とは異なる所定の熱膨張係数を有する平板部材を貼着し、所定の温度以上に加熱した後、常温に戻すと、該基板と該平板部材のうち、熱膨張係数の大きい方が小さい方よりも昇温とともに大きく膨張し、降温とともに大きく収縮する。

【0029】したがって、平板部材の熱膨張係数が基板の熱膨張係数より小さい場合には、基板と平板部材とは、平板部材側が凸になるように湾曲する。一方、平板部材の熱膨張係数が基板の熱膨張係数より大きい場合には、基板と平板部材とは、基板側が凸になるように湾曲する。

【0030】このように基板と平板部材の熱膨張係数の差を制御することにより、シール材の形成工程において湾曲するもう一方の熱膨張係数が小さい基板と同一の形状に、基板をあらかじめ湾曲させることができるので、液晶セルのセル厚を均一化することができる。

【0031】すなわち、上記課題を解決するために本発明が講じた手段は、周縁部においてシール材を介して所定の間隔で貼着された、液晶層を挟持する対向する2枚の基板が異なる材料からなる液晶装置の製造方法において、前記対向する2枚の基板のうち、熱膨張係数の大きい基板の外表面上に、接着剤を介して、該基板とは異なる所定の熱膨張係数を有する平板部材を貼着し、所定の温度以上に加熱した後、常温に戻すことにより、該基板と該平板部材とを所定の形状に湾曲させた後、該基板ともう一方の前記基板とを前記シール材を介して貼着することを特徴とする。

【0032】この手段によれば、液晶層を挟持する対向する2枚の基板のうち、熱膨張係数の大きい基板をあらかじめ所定の形状に湾曲させることにより、シール材の形成工程において湾曲するもう一方の基板との間隔(液晶セルのセル厚)を均一化することができる液晶装置の製造方法を提供することができる。

【0033】また、この手段により、周縁部においてシール材を介して所定の間隔で貼着された、液晶層を挟持する対向する2枚の基板が異なる材料からなる液晶装置において、前記対向する2枚の基板のうち、熱膨張係数の大きい基板の外表面上に、接着剤を介して、該基板とは異なる所定の熱膨張係数を有する平板部材が貼着され、該基板、該平板部材、もう一方の前記基板が所定の形状に湾曲されたことを特徴とする、表示品質の優れた液晶装置を提供することができる。

【0034】また、この液晶装置を備えることにより、表示品質の優れた電子機器を提供することができる。

【0035】以上の手段において、前記平板部材が前記基板の熱膨張係数より小さい熱膨張係数を有するものである場合には、前記基板と前記平板部材とを該平板部材

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側が凸になるように湾曲させたことを特徴とする。前記平板部材が前記基板の熱膨張係数より大きい熱膨張係数を有するものである場合には、前記基板と前記平板部材とを該基板側が凸になるように湾曲させたことを特徴とする。

【0036】いずれの場合においても、前記基板と前記平板部材の熱膨張係数の差が、前記もう一方の基板と前記基板の熱膨張係数の差に等しいことが望ましい。前記基板と前記平板部材の熱膨張係数の差を、前記もう一方の基板と前記基板の熱膨張係数の差と等しくすることにより、前記平板部材を貼着した前記基板をもう一方の基板と同一の形状に湾曲させることができる。

【0037】また、前記接着剤は前記シール材と同一の材料からなることが望ましい。前記接着剤を前記シール材と同一の材料とし、該シール材を硬化する条件で該接着剤を硬化することにより、前記平板部材を貼着した前記基板をもう一方の基板と同一の形状に湾曲させることができる。

【0038】

【発明の実施の形態】次に、本発明に係る実施形態について詳細に説明する。

【0039】第1実施形態

図1(a)～(e)に、本発明に係る第1実施形態の、スイッチング素子としてMOSFET（メタルオキシドシリコンフィールドエミッショントランジスタ）素子20を用いる反射型液晶表示装置10の製造方法を示す工程図を示し、この製造方法を説明する。図1(a)～(e)は概略断面図を示している。

【0040】本実施形態においては、液晶層13を挟持する基板（下側基板）11と対向基板（上側基板）12として、異なる基板が用いられており、対向基板12の熱膨張係数の方が基板11の熱膨張係数より小さくなっている。例えば、基板11、対向基板12として、それぞれ単結晶シリコン、ガラスからなる基板が用いられている。また、基板11、対向基板12を貼着するシール材14の形成工程において、対向基板12は内表面側（液晶層13側）が凸になるように湾曲するものとする。

【0041】図1(a)に示すように、基板11の内表面（図示上側表面）上には、光を反射するアルミニウムなどからなる画素電極（反射電極）15と、各画素電極15を駆動するためのMOSFET素子20などを形成し、画素電極15、MOSFET素子20上には配向膜18を形成する。

【0042】図2に、配向膜18を形成する前の基板11を上から見たときの様子を拡大した平面図を示す。図1(a)は、図2のA-A'線に沿って示す断面図である。

【0043】図2に示すように、基板11上には、走査線22とデータ線16がマトリックス状に配置され、走

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査線22とデータ線16との交点に応じて各画素が配置され、各画素には画素電極15と、各画素電極15を駆動するためのMOSFET素子20とが設けられている。MOSFET素子20の詳細な説明については後述する。

【0044】次に、図1(b)に示すように、基板11の外表面（図示下側表面）上に、熱硬化性接着剤又は光硬化性接着剤を介して、基板11とは異なる所定の熱膨張係数を有する平板部材11Aを貼着する。このとき、平板部材11Aの熱膨張係数が基板11の熱膨張係数より小さくなるように平板部材11Aを選定する。また、対向基板12と基板11の熱膨張係数の差と、基板11と平板部材11Aの熱膨張係数の差が等しくなるように、設定することが望ましい。平板部材11Aは対向基板12と同一の材料から構成されてもよい。

【0045】基板11と平板部材11Aを貼着した接着剤が熱硬化性接着剤の場合には、100～160℃程度に加熱することにより接着剤の硬化を行う。また、用いた接着剤が光硬化性接着剤の場合には紫外線等を照射することにより接着剤の硬化を行う。光硬化性接着剤の硬化には紫外線ランプを使用し、紫外線ランプの発熱により80℃程度まで昇温する。また、いずれの接着剤を用いた場合においても硬化反応終了後は常温まで温度を下げる。

【0046】用いた接着剤が熱硬化性接着剤、光硬化性接着剤のいずれの場合においても基板11と平板部材11Aとは100～160℃程度あるいは80℃程度の温度に加熱される。このとき、基板11と対向基板11Aのうち、熱膨張係数の大きい基板11が熱膨張係数の小さい平板部材11Aよりも昇温とともに大きく膨張し、降温とともに大きく収縮する。

【0047】その結果、図1(c)に示すように、基板11と平板部材11Aとは、平板部材11A側が凸になるように湾曲する。

【0048】次に、図1(d)に示すように、共通電極17、配向膜19が内表面上に順次形成された対向基板12と基板11とを、熱硬化性接着剤又は光硬化性接着剤からなる未硬化のシール材14Aを介して所定の間隔で貼着する。

【0049】次に、図1(e)に示すように、シール材14Aの硬化を行い、シール材14を形成する。シール材14Aが熱硬化性接着剤の場合には、100～160℃程度に加熱することにより接着剤の硬化を行う。また、シール材14Aが光硬化性接着剤の場合には紫外線等を照射することにより接着剤の硬化を行う。光硬化性接着剤の硬化には紫外線ランプを使用し、紫外線ランプの発熱により80℃程度まで昇温する。また、いずれの接着剤を用いた場合においても、硬化反応終了後は常温まで温度を下げる。

【0050】シール材14Aとして用いた接着剤が熱硬

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化性接着剤、光硬化性接着剤のいずれの場合においても、基板11と平板部材11Aとは100～160℃あるいは80℃程度の温度に加熱される。このとき、対向基板12の熱膨張係数が基板11の熱膨張係数より小さいため、小さい対向基板12は基板11よりも大きく熱膨張する。しかしながら、対向基板12の周縁部はシール材14A又は14によって固定されているため、対向基板12は内表面側が凸になるように湾曲する。

【0051】最後に、基板11、対向基板12間に液晶層13を封入し、図示では省略しているが平板部材11A、対向基板12の外側に位相差板、偏光板を設置し、液晶表示装置10は製造される。

【0052】ここで、MOSFET（メタルオキシドシリコンフィールドエミッショントランジスタ）素子20の詳細について説明する。

【0053】図3に、MOSFET素子20の詳細を示すために、図2のB-B'線に沿って示す断面図を示す。

【0054】基板11上には、ウェル領域21が形成され、ウェル領域21上には素子分離用のフィールド酸化膜23が形成されている。フィールド酸化膜23には開口部が形成され、この開口部の内側中央に、ゲート酸化膜24が形成され、ゲート酸化膜24表面にはゲート電極22a及び走査線22が形成され、その上に第1の層間絶縁膜25が形成されている。コンタクトホール26はソース領域42aに形成され、これにより第1の層間絶縁膜25は開口し、ここにデータ線16が形成され、ソース領域42aとの接続が図られている。また、データ線16が形成された後には、さらに第2の層間絶縁膜27が形成される。コンタクトホール28は、ドレイン領域42bに形成され、これにより、第1の層間絶縁膜25、第2の層間絶縁膜27が開口し、ここに、画素電極15が形成されて、ドレイン領域42bとの接続が図られている。また、第1の層間絶縁膜25と第2の層間絶縁膜27との間には容量蓄積用の導電層29が形成される。

【0055】本実施形態においては、基板11、対向基板12のうち、対向基板12の熱膨張係数が基板11の熱膨張係数より小さい液晶表示装置について説明したが、本発明はこれに限定されるものではなく、基板11の熱膨張係数が対向基板12の熱膨張係数より小さいてもよく、その場合には、対向基板12の外表面上に対向基板12の熱膨張係数より小さい熱膨張係数を有する平板部材11Aを貼着し、対向基板12と平板部材11Aとを、平板部材11A側が凸になるように湾曲すればよい。

【0056】本実施形態によれば、基板11の外表面上に熱膨張係数の異なる所定の熱膨張係数を有する平板部材11Aを貼着し、所定の温度以上に昇温し、常温に戻すことにより、基板11を所定の形状に湾曲することが

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できる。

【0057】本実施形態において、対向基板12と基板11の熱膨張係数の差と、基板11と平板部材11Aの熱膨張係数の差が等しくなるように、設定することが望ましい。また、基板11と平板部材11Aとを貼着する接着剤として、シール材14Aと同一の接着剤が用いられることが望ましい。

【0058】対向基板12と基板11の熱膨張係数の差と、基板11と平板部材11Aの熱膨張係数の差が等しくなるように設定し、基板11と平板部材11Aとを貼着する接着剤として、シール材14Aと同一の接着剤を用い、同一条件下で接着剤の硬化を行うことにより、基板11と対向基板12とを、同一の形状に湾曲させることができる。

【0059】このように、本実施形態によれば、基板11を、シール材14の形成工程において湾曲する対向基板12と同一の形状に湾曲することができるので、液晶セルのセル厚が均一化され、表示品質の優れた液晶表示装置の製造方法及び液晶表示装置を提供することができる。

【0060】また、本実施形態においては、反射型液晶表示装置について説明したが、本発明は反射型に限定されるものではなく、透過型、反射半透過型など、いかなる液晶装置にも適用することができる。なお、本実施形態はスペーサーを配置することができない投射型液晶ディスプレイ用の液晶表示装置には特に有効である。

【0061】第2実施形態図4に、本発明に係る第2実施形態の、スイッチング素子としてMOSFET素子を用いる反射型液晶表示装置30の製造方法を示す工程図を示し、製造方法を説明する。図4において、液晶表示装置10と同じ構成要素には同じ参照符号を付している。

【0062】本実施形態においては、液晶層13を挟持する基板（下側基板）31と対向基板（上側基板）32として、異なる基板が用いられており、対向基板32の熱膨張係数の方が基板31の熱膨張係数より小さくなって小さくいる。例えば、基板31、対向基板32として、それぞれ単結晶シリコン、ガラスからなる基板が用いられている。また、基板31、対向基板32を貼着するシール材14の形成工程において、対向基板32は外表面側が凸になるように湾曲するものとする。

【0063】図4(a)に示すように、基板31の内表面（図示上側表面）上には、第1実施形態と同様、光を反射するアルミニウムなどからなる画素電極（反射電極）15と、各画素電極15を駆動するためのMOSFET素子20などが設けられている。

【0064】配向膜18を形成する前の基板31を上から見たときの様子を拡大した平面図、及びMOSFET素子20の詳細な構造は図2、図3で示したものと同様であるので、説明は省略する。

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【0065】次に、図4(b)に示すように、基板31の外表面(図示下側表面)上に、熱硬化性接着剤又は光硬化性接着剤を介して、基板31とは異なる所定の熱膨張係数を有する平板部材31Aを貼着する。このとき、平板部材31Aの熱膨張係数が基板31の熱膨張係数より大きくなるように平板部材31Aを選定する。また、対向基板32と基板31の熱膨張係数の差と、基板31と平板部材31Aの熱膨張係数の差が等しくなるように、設定することが望ましい。

【0066】基板31と平板部材31Aとを貼着した接着剤が熱硬化性接着剤の場合には、100～160℃程度に加熱することにより接着剤の硬化を行う。また、用いた接着剤が光硬化性接着剤の場合には紫外線等を照射することにより接着剤の硬化を行う。光硬化性接着剤の硬化には紫外線ランプを使用し、紫外線ランプの発熱により80℃程度まで昇温する。また、いずれの接着剤を用いた場合においても硬化反応終了後は常温まで温度を下げる。

【0067】用いた接着剤が熱硬化性接着剤、光硬化性接着剤のいずれの場合においても、基板31と平板部材31Aとは100～160℃程度あるいは80℃程度の温度に加熱される。このとき、基板31と平板部材31Aのうち、熱膨張係数の大きい平板部材31Aが熱膨張係数の小さい基板31よりも昇温とともに大きく膨張し、降温とともに大きく収縮する。

【0068】その結果、図4(c)に示すように、基板31と平板部材31Aとは、基板31側が凸になるように湾曲する。

【0069】次に、図4(d)に示すように、共通電極17、配向膜19が内表面上に順次形成された対向基板32と基板31とを、熱硬化性接着剤又は光硬化性接着剤からなる未硬化のシール材14Aを介して所定の間隔で貼着する。

【0070】次に、図4(e)に示すように、シール材14Aの硬化を行い、シール材14を形成する。シール材14Aが熱硬化性接着剤の場合には、100～160℃程度に加熱することにより接着剤の硬化を行う。また、シール材14Aが光硬化性接着剤の場合には紫外線等を照射することにより接着剤の硬化を行う。光硬化性接着剤の硬化には紫外線ランプを使用し、紫外線ランプの発熱により80℃程度まで昇温する。また、いずれの接着剤を用いた場合においても、硬化反応終了後は常温まで温度を下げる。

【0071】シール材14Aとして用いた接着剤が熱硬化性接着剤、光硬化性接着剤のいずれの場合においても、基板31と平板部材31Aとは100～160℃程度あるいは80℃程度の温度に加熱される。このとき、対向基板32の熱膨張係数が基板31の熱膨張係数より小さいため、基板31は対向基板32よりも大きく熱膨張する。しかしながら、対向基板32の周縁部はシール

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材14A又は14によって固定されているため、対向基板32は外表面側が凸になるように湾曲する。

【0072】最後に、基板31、対向基板32間に液晶層13を封入し、図示では省略しているが平板部材31A、対向基板32の外側に位相差板、偏光板を設置し、液晶表示装置30は製造される。

【0073】本実施形態においては、基板31、対向基板32のうち、対向基板32の熱膨張係数が基板31の熱膨張係数より小さい液晶表示装置について説明したが、本発明はこれに限定されるものではなく、対向基板32の熱膨張係数が基板31の熱膨張係数より大きくてもよく、その場合には、対向基板32の外表面上に対向基板32の熱膨張係数より大きい熱膨張係数を有する平板部材31Aを貼着し、対向基板32と平板部材31Aとを、対向基板32側が凸になるように湾曲すればよい。

【0074】本実施形態によれば、基板31の外表面上に熱膨張係数の異なる所定の熱膨張係数を有する平板部材31Aを貼着し、所定の温度以上に昇温し、常温に戻すことにより、基板31を所定の形状に湾曲することができる。

【0075】本実施形態において、対向基板32と基板31の熱膨張係数の差と、基板31と平板部材31Aの熱膨張係数の差が等しくなるように、設定することが望ましい。また、基板31と平板部材31Aとを貼着する接着剤として、シール材14Aと同一の接着剤が用いられることが望ましい。

【0076】対向基板32と基板31の熱膨張係数の差と、基板31と平板部材31Aの熱膨張係数の差が等しくなるように設定し、基板31と平板部材31Aとを貼着する接着剤として、シール材14Aと同一の接着剤を用い、同一条件下で接着剤の硬化を行うことにより、基板31と対向基板32とを、同一の形状に湾曲させることができる。

【0077】このように、本実施形態によれば、基板31を、シール材14の形成工程において湾曲する対向基板32と同一の形状に湾曲することができるので、液晶セルのセル厚が均一化され、表示品質の優れた液晶表示装置の製造方法及び液晶表示装置を提供することができる。

【0078】また、本実施形態においては、反射型液晶表示装置について説明したが、本発明は反射型に限定されるものではなく、透過型、反射半透過型など、いかなる液晶装置にも適用することができる。本実施形態はスペーサーを配置することができない投射型ディスプレイ用の液晶表示装置、スペーサーを配置する直視型液晶ディスプレイ用の液晶表示装置のいずれにも有効である。

【0079】なお、第1、第2実施形態においては、MOSFET素子を用いる液晶表示装置についてのみ説明したが、本発明はこれに限定されるものではなく、例え

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は、単純マトリックスタイプの液晶装置や、MIM (Metal-Insulator-Metal) 素子に代表される2端子型素子を用いる液晶装置、TFT (Thin-Film Transistor) 素子に代表される3端子型素子を用いる液晶装置にも適用することができ、液晶層を挟持する対向する2枚の基板が異なる材料からなる液晶装置であれば、いかなる液晶装置にも適用することができる。

【0080】次に、前記の第1、第2実施形態の液晶表示装置10又は30のいずれかを備えた電子機器の具体例について説明する。

【0081】図5(a)は、携帯電話の一例を示した斜視図である。図5(a)において、40は携帯電話本体を示し、41は前記の液晶表示装置10又は30のいずれかを備えた液晶表示部を示している。

【0082】図5(b)は、ワープロ、パソコンなどの携帯型情報処理装置の一例を示した斜視図である。図5(b)において、50は情報処理装置、51はキーボードなどの入力部、53は情報処理本体、52は前記の液晶表示装置10又は30のいずれかを備えた液晶表示部を示している。

【0083】図5(c)は、腕時計型電子機器の一例を示した斜視図である。図5(c)において、60は時計本体を示し、61は前記の液晶表示装置10又は30のいずれかを備えた液晶表示部を示している。

【0084】図6は、前記の液晶表示装置10又は30のいずれかを光変調装置として用いたプロジェクタ（投射型液晶ディスプレイ）の要部を示す概略構成図である。

【0085】このプロジェクタは、システム光軸Lに沿って配置した光源部71、インテグレートレンズ72、偏光変換素子73から概略構成される偏光照明装置70。偏光照明装置70から出射されたS偏光光束をS偏光光束反射面81により反射させる偏光ビームスプリッタ80、偏光ビームスプリッタ80のS偏光反射面81から反射された光のうち、青色光(B)の成分を分離するダイクロイックミラー82、分離された青色光(B)を変調する反射型液晶光変調装置85B、青色光が分離された後の光束のうち赤色光(R)の成分を反射させて分離するダイクロイックミラー83、分離された赤色光(R)を変調する反射型液晶光変調装置85R、ダイクロイックミラー83を透過する残りの緑色光(G)を変調する反射型液晶光変調装置85G、3つの反射型液晶光変調装置85R、85G、85Bにて変調された光をダイクロイックミラー82、83、偏光ビームスプリッタ80にて合成し、この合成光をスクリーン91に投射する投射レンズからなる投射光学系90から構成されている。上記3つの反射型液晶光変調装置85R、85G、85Bには、それぞれ前記の液晶表示装置10又は30のいずれかが用いられている。

【0086】図5(a)~(c)、図6に示すそれぞれの電子

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機器は、前記の液晶表示装置10又は30のいずれかを備えたものであるので、表示品質の優れたものとなる。

【0087】

【発明の効果】以上説明したように本発明によれば、液晶層を挟持する対向する2枚の基板が異なる材料から構成されている場合において、2枚の基板のうち、熱膨張係数の大きい基板の外表面上に、該基板とは熱膨張係数の異なる所定の熱膨張係数を有する平板部材を貼着し、所定の温度以上に昇温し、常温に戻すことにより、該基板を所定の形状に湾曲させることができるので、該基板を、シール材の形成工程において湾曲するもう一方の基板と同一の形状にすることができ、液晶セルのセル厚が均一化され、表示品質の優れた液晶表示装置の製造方法及び液晶表示装置を提供することができる。

【0088】また、この液晶表示装置を備えることにより表示品質の優れた電子機器を提供することができる。

【図面の簡単な説明】

【図1】 図1(a)~(e)は本発明に係る第1実施形態の反射型液晶表示装置の製造方法を示す工程図である。

【図2】 図2は本発明に係る第1実施形態の反射型液晶表示装置を拡大して示す平面図である。

【図3】 図3は本発明に係る第1実施形態の反射型液晶表示装置におけるTFT素子の構造を示す断面図である。

【図4】 図4(a)~(e)は本発明に係る第2実施形態の反射型液晶表示装置の製造方法を示す工程図である。

【図5】 図5(a)は上記実施形態により製造された液晶表示装置を備えた携帯電話の一例を示す図、図5(b)は上記実施形態により製造された液晶表示装置を備えた携帯型情報処理装置の一例を示す図、図5(c)は上記実施形態により製造された液晶表示装置を備えた腕時計型電子機器の一例を示す図である。

【図6】 図6は上記実施形態により製造された液晶表示装置を光変調装置として用いたプロジェクタの要部を示す概略構成図である。

【図7】 図7は直視型液晶ディスプレイ用の一般の液晶表示装置の構造を示す概略断面図である。

【図8】 図8は投射型液晶ディスプレイ用の一般の液晶表示装置の構造を示す概略断面図である。

【図9】 図9は投射型液晶ディスプレイ用の反射型液晶表示装置の構造を示す概略断面図である。

【図10】 図10(a)、(b)は投射型液晶ディスプレイ用の反射型液晶表示装置における基板の湾曲の問題を説明する図である。

【符号の説明】

10、30	液晶表示装置
11、31	基板
11A、31A	平板部材
12、32	対向基板
13	液晶層

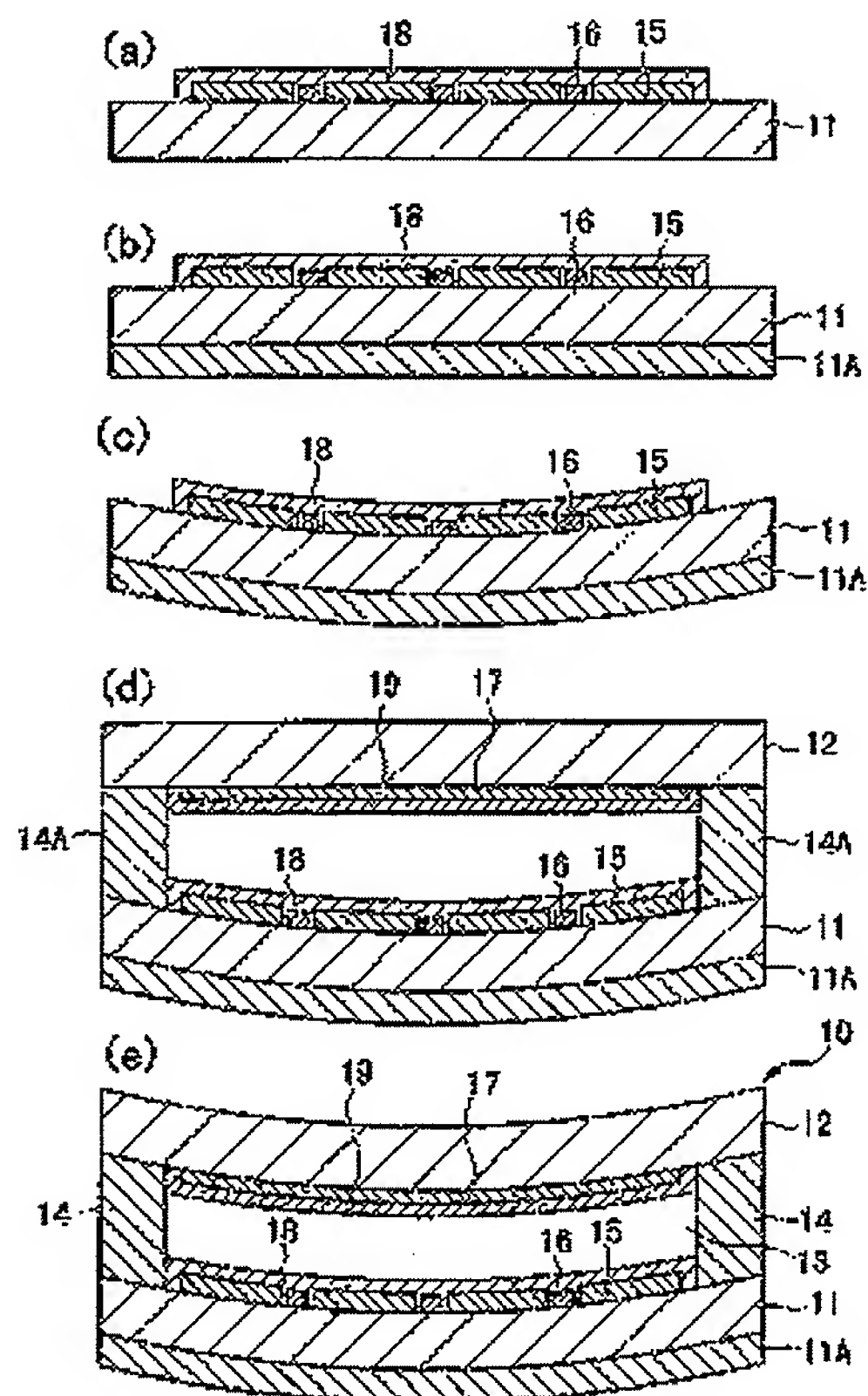
14 シール材
14A 未硬化のシール材
15 画素電極（反射電極）
16 データ線

(9)

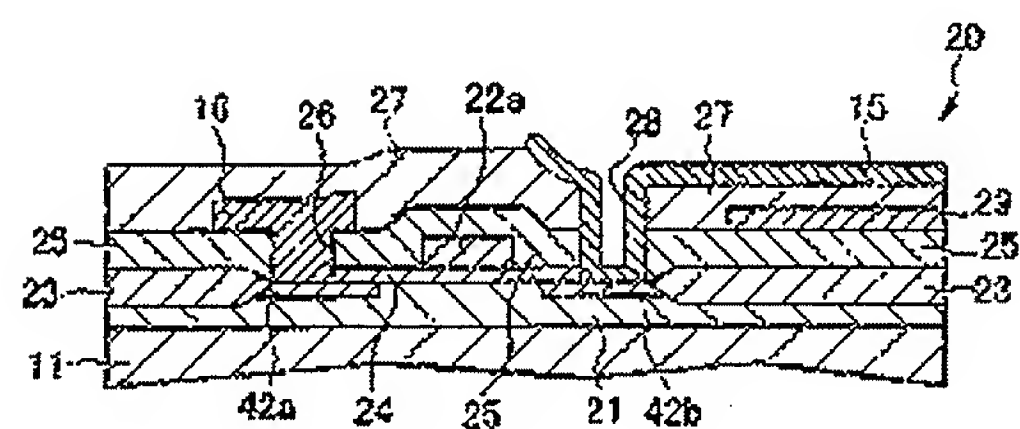
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16 共通電極
* 17 配向膜
18, 19 MOSFET素子
20 走査線
* 22

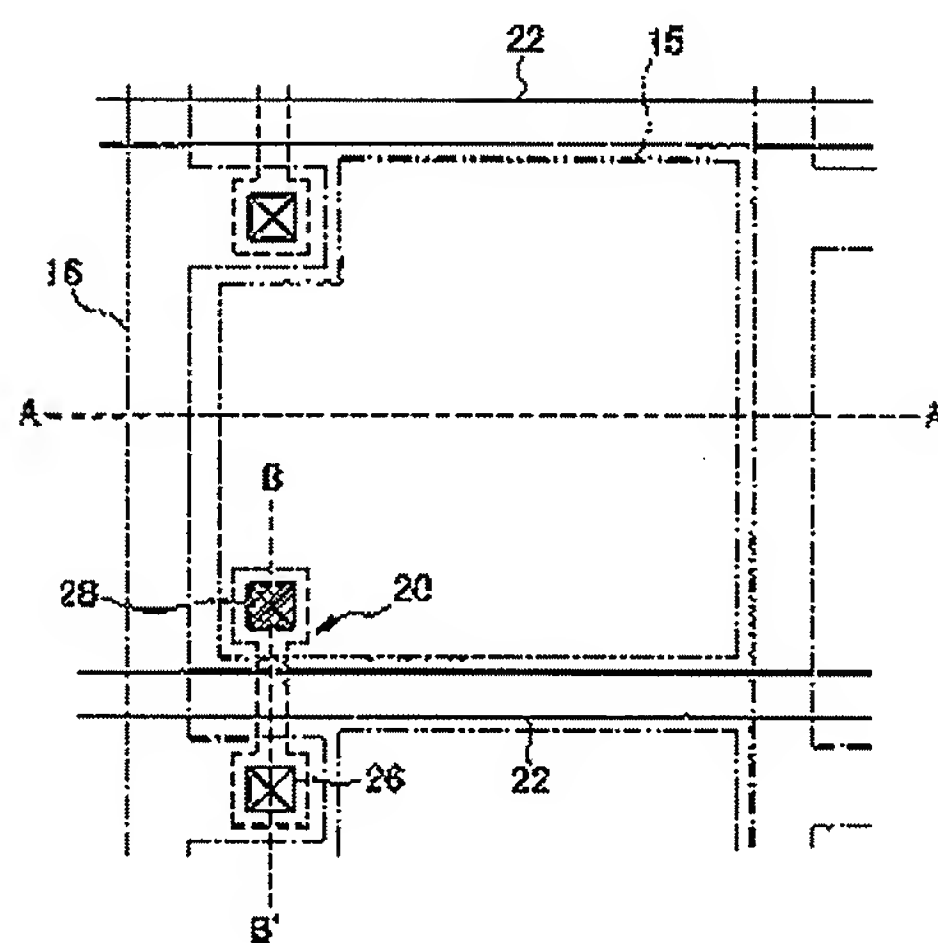
【図1】



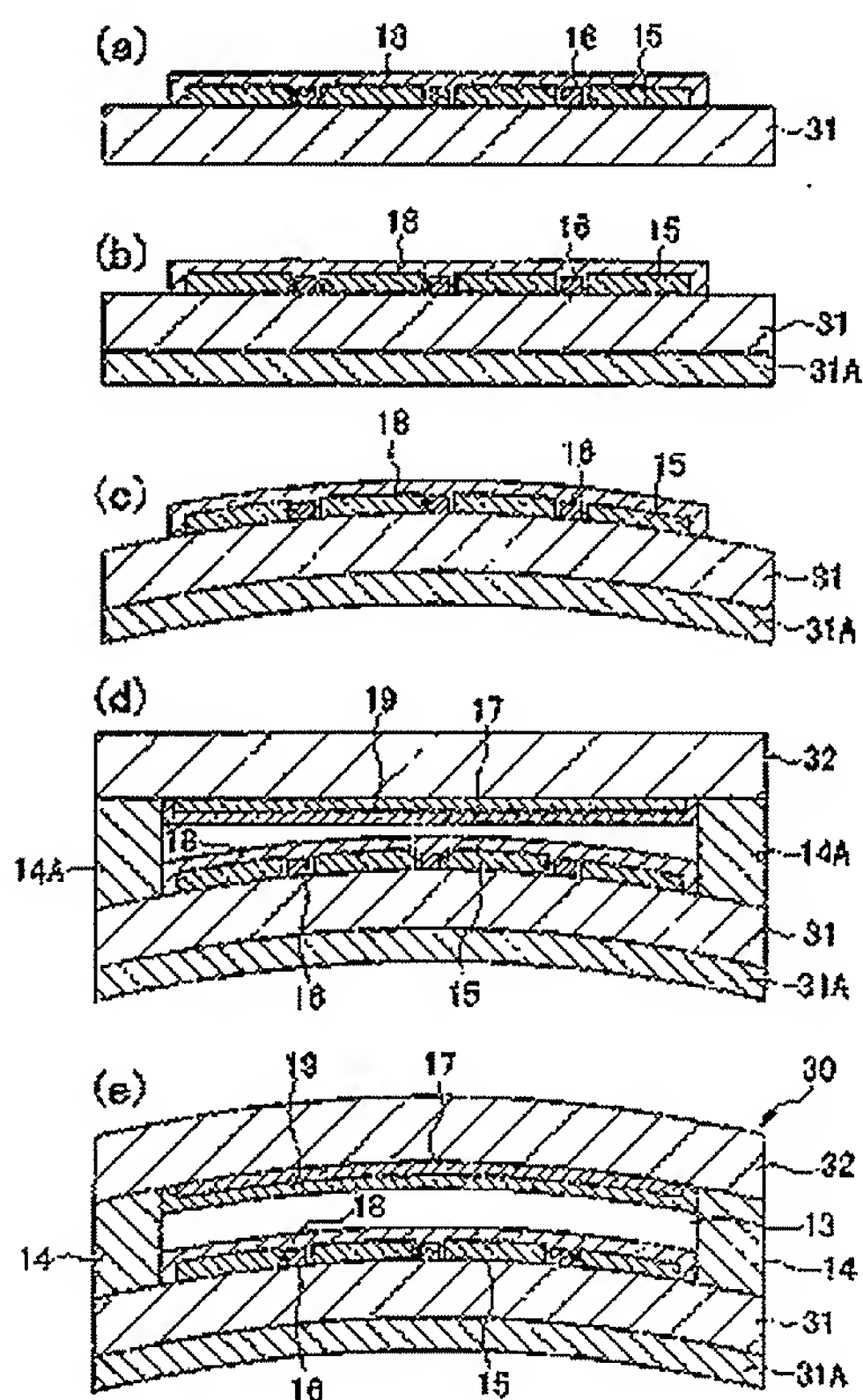
【図3】



【図2】



【図4】



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CLAIMS

[Claim(s)]

[Claim 1] In the manufacture approach of the liquid crystal equipment which consists of an ingredient with which two substrates which were stuck at the predetermined spacing through the sealant in the periphery section, which pinch a liquid crystal layer, and which counter differ After sticking the monotonous member which has a different predetermined coefficient of thermal expansion from this substrate through adhesives on the outside surface of the substrate with a large coefficient of thermal expansion between said two substrates which counter and heating beyond predetermined temperature, by returning to ordinary temperature The manufacture approach of the liquid crystal equipment characterized by sticking this substrate and said another substrate through said sealant after incurvating this substrate and this monotonous member in a predetermined configuration.

[Claim 2] It is the manufacture approach of the liquid crystal equipment characterized by for said monotonous member having a coefficient of thermal expansion smaller than the coefficient of thermal expansion of said substrate in the manufacture approach of liquid crystal equipment according to claim 1, and incurvating said substrate and said monotonous member so that this monotonous member side may become a convex.

[Claim 3] The manufacture approach of liquid crystal equipment that the difference of the coefficient of thermal expansion of said substrate and said monotonous member is characterized by being equal to the difference of the coefficient of thermal expansion of another [said] substrate and said substrate in the manufacture approach of liquid crystal equipment according to claim 2.

[Claim 4] It is the manufacture approach of the liquid crystal equipment characterized by for said monotonous member having a larger coefficient of thermal expansion than the coefficient of thermal expansion of said substrate in the manufacture approach of liquid crystal equipment according to claim 1, and incurvating said substrate and said monotonous member so that this substrate side may become a convex.

[Claim 5] The manufacture approach of liquid crystal equipment that the difference of the coefficient of thermal expansion of said substrate and said monotonous member is characterized by being equal to the difference of the coefficient of thermal expansion of another [said] substrate and said substrate in the manufacture approach of liquid crystal equipment according to claim 4.

[Claim 6] The manufacture approach of the liquid crystal equipment characterized by said adhesives consisting of the same ingredient as said sealant in the manufacture approach of liquid crystal equipment given [from claim 1 to claim 5] in any 1 term.

[Claim 7] In the liquid crystal equipment which consists of an ingredient with which two substrates which were stuck at the predetermined spacing through the sealant in the periphery section, which pinch a liquid crystal layer, and which counter differ Liquid crystal equipment which the monotonous member which has a different predetermined coefficient of thermal expansion from this substrate is stuck through adhesives on the outside surface of the substrate with a large coefficient of thermal expansion between said two substrates which counter, and is characterized by this substrate, this monotonous member, and said another substrate curving in a predetermined configuration.

[Claim 8] It is liquid crystal equipment which said monotonous member has a coefficient of thermal expansion smaller than the coefficient of thermal expansion of said substrate in liquid crystal equipment according to claim 7, and is characterized by for said substrate and said monotonous member having curved so that this monotonous member side might become a convex, and another [said] substrate curving so that an internal-surface side may become a convex.

[Claim 9] Liquid crystal equipment with which the difference of the coefficient of thermal expansion of said

substrate and said monotonous member is characterized by being equal to the difference of the coefficient of thermal expansion of another [said] substrate and said substrate in liquid crystal equipment according to claim 8.

[Claim 10] It is liquid crystal equipment which said monotonous member has a larger coefficient of thermal expansion than the coefficient of thermal expansion of said substrate in liquid crystal equipment according to claim 7, and is characterized by for said substrate and said monotonous member having curved so that this substrate side might become a convex, and another [said] substrate curving so that an outside-surface side may become a convex.

[Claim 11] Liquid crystal equipment with which the difference of the coefficient of thermal expansion of said substrate and said monotonous member is characterized by being equal to the difference of the coefficient of thermal expansion of another [said] substrate and said substrate in liquid crystal equipment according to claim 10.

[Claim 12] Liquid crystal equipment characterized by said adhesives consisting of the same ingredient as said sealant in liquid crystal equipment given [from claim 7 to claim 11] in any 1 term.

[Claim 13] Electronic equipment characterized by having liquid crystal equipment given [from claim 7 to claim 12] in any 1 term.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to electronic equipment equipped with the liquid crystal equipment manufactured by the manufacture approach of the liquid crystal equipment which consists of an ingredient with which two substrates which are applied to the manufacture approach, liquid crystal equipment, and electronic equipment of liquid crystal equipment, especially pinch a liquid crystal layer, and which counter differ, and this manufacture approach, and this liquid crystal equipment.

[0002]

[Description of the Prior Art] As a liquid crystal display, the direct viewing type liquid crystal display carried in a cellular phone, a pocket mold information processor, etc. and projection mold liquid crystal displays, such as a projector, are known.

[0003] The outline sectional view of the common liquid crystal display 100 used for a direct viewing type liquid crystal display is shown in drawing 7, and the structure of this liquid crystal display is explained to it.

[0004] As shown in drawing 7, a substrate (bottom substrate) 101 and the opposite substrate (top substrate) 102 are stuck at intervals of predetermined through a sealant 104 in each periphery section, and the liquid crystal layer 103 is enclosed between the substrate 101 and the opposite substrate 102. On the inside of a substrate 101 and the opposite substrate 102, transparent electrodes 105 and 106 are formed by the predetermined pattern, respectively, and the orientation film 107 and 108 is formed on a transparent electrode 105 and 106.

[0005] Although a phase contrast plate and a polarizing plate are installed in the outside of a substrate 101 and the opposite substrate 102, it is omitting in illustration.

[0006] In the liquid crystal display 100, in order to keep constant spacing (cell thickness of a liquid crystal cell) of a substrate 101 and the opposite substrate 102, many spherical spacers 109 which consist of a silicon dioxide, polystyrene, etc. are arranged between the substrate 101 and the opposite substrate 102.

[0007] Next, the outline sectional view of the common liquid crystal display 200 used for a projection mold liquid crystal display is shown in drawing 8, and the structure of this liquid crystal display is explained to it. In drawing 8, the same reference number is given to the same component as a liquid crystal display 100, and explanation is omitted.

[0008] In a liquid crystal display 200, since a spacer is also expanded and displayed when the spacer has been arranged between a substrate 101 and the opposite substrate 102 in order to display by carrying out expansion projection of the liquid crystal panel, optical leakage arises into the part and there is a problem of reducing display quality. Therefore, in a liquid crystal display 200, as shown in drawing 8, a spacer cannot be arranged between a substrate 101 and the opposite substrate 102.

[0009]

[Problem(s) to be Solved by the Invention] In a common liquid crystal display as shown with the above-mentioned liquid crystal display 100,200, although the same substrate is usually used as a substrate 101 and an opposite substrate 102, a different substrate may be used.

[0010] The reflective mold liquid crystal display 300 with which a different substrate is used as a substrate 101 and an opposite substrate 102 and which is used for a projection mold display as an example at drawing 9 is shown, and the structure of this liquid crystal display is explained. In drawing 9, the same reference number is given to the same component as a liquid crystal display 200, and explanation is omitted.

[0011] On the substrate 101, many reflectors 305 which consist of aluminum which reflects light are formed in the shape of a matrix, and the switching element for driving each reflector 305 is prepared. The orientation film

107 is formed on the reflector 305 and the switching element.

[0012] In this liquid crystal display 300, the light which carried out incidence into the liquid crystal panel from the outside of the opposite substrate 102 passes the liquid crystal layer 103, it is reflected on reflector 305 front face, and it passes the opposite substrate 102, and is emitted to the exterior of a liquid crystal panel.

[0013] In this liquid crystal display 300, when a substrate 101 consists of single crystal ingredients, such as single crystal silicon, and the switching element is formed on this single crystal substrate, the reflector 305 formed on a substrate 101 can be switched to a high speed rather than the time of consisting of a switching element formed on amorphous materials, such as glass.

[0014] Since the light reflected with the reflector 305 passes the opposite substrate 102 on the other hand, it is emitted to the exterior of a liquid crystal display 300 and a display is performed, it is needed that the opposite substrate 102 is transparent. Therefore, opaque single crystal silicon etc. cannot be used as an opposite substrate 102.

[0015] Therefore, since the substrate which consists of single crystal ingredients, such as single crystal silicon, as a substrate 101 is used and the substrate which consists of transparent materials, such as glass, as an opposite substrate 102 is used when forming a transistor on the case where the high-speed response of the reflective mold liquid crystal display 300 is carried out, or a substrate 101, the substrate which consists of a different ingredient as a substrate 101 and an opposite substrate 102 is used.

[0016] In the liquid crystal display 300 with which a different substrate is used as a substrate 101 and an opposite substrate 102, in the production process of a liquid crystal display 300, in case a sealant 104 is formed, it has the trouble of producing cel thickness nonuniformity between a substrate 101 and the opposite substrate 102.

[0017] A sealant 104 applies thermosetting adhesive or photoresist adhesives between the periphery sections of a substrate 101 and the opposite substrate 102, and is formed by hardening adhesives. In the case of thermosetting adhesive, hardening of adhesives is performed by usually heating at about 100-160 degrees C, and, in the case of photoresist adhesives, is performed by irradiating ultraviolet rays etc. In the case of photoresist adhesives, heating is not performed, but it is generation of heat from that of an ultraviolet ray lamp, and a temperature up is carried out to about 80 degrees C.

[0018] Therefore, as a sealant 104, when using any of thermosetting adhesive and photoresist adhesives, a liquid crystal cell is heated by about 100-160 degrees C or about 80 degrees C.

[0019] Since a different substrate as a substrate 101 and an opposite substrate 102 is used in that case, the coefficients of thermal expansion of a substrate 101 and the opposite substrate 102 differ, and a substrate with a large coefficient of thermal expansion expands greatly with a temperature rise as compared with a substrate with a small coefficient of thermal expansion. Furthermore, since the periphery section of a substrate is being fixed by the sealant 104, a curve arises in the substrate which expanded.

[0020] For example, when single crystal silicon and the opposite substrate 102 consist [a substrate 101] of glass, it curves so that the internal-surface side of the opposite substrate 102 may become a convex, or since the coefficient of thermal expansion is larger than glass, as the direction of single crystal silicon shows the opposite substrate 102 to drawing 10 (a), as shown in drawing 10 $R > 0$ (b), it curves so that the outside-surface side of the opposite substrate 102 may become a convex. When the opposite substrate 102 is level, the gap from from is the most remarkable also in curve [which / of the opposite substrate 102 shown in drawing 10 (a) and (b)] in the center section of the opposite substrate 102. For example, as for gap g in the center section of the opposite substrate 102, the thickness of 0.6×10^{-6} to 3×10^{-6} m and the opposite substrate 102 is about 1×10^{-6} m, when the thickness of a substrate 101 is 0.7×10^{-6} to 3×10^{-6} m. Therefore, there is a trouble that distribution of an about [1×10^{-6} m] arises also in the thickness (cel thickness of a liquid crystal cell) of the liquid crystal layer 103 pinched by a substrate 101 and the opposite substrate 102. Since the cel thickness of a liquid crystal cell is about $3-6 \times 10^{-6}$ m, this gap is large.

[0021] If the above problem is a liquid crystal display which consists of a substrate with which a substrate 101 differs from the opposite substrate 102 instead of the problem restricted to the reflective mold liquid crystal display 300 for a projection mold display, it is a problem produced in any liquid crystal displays.

[0022] In the common liquid crystal display 100 for direct viewing type liquid crystal displays which arranges a spacer 109, although the curve of the opposite substrate 102 shown by drawing 10 (a) can be prevented, even if it arranges a spacer 109, the curve of the opposite substrate 102 shown by drawing 10 (b) cannot be prevented.

[0023] Moreover, neither of the curves of the opposite substrates 102 shown by drawing 10 (a) and drawing 10

(b) can be prevented, but a problem is remarkable in the common liquid crystal display 200 (300 is included) for projection mold liquid crystal displays which does not arrange a spacer.

[0024] Here, a problem in case distribution arises is explained to the cel thickness of a liquid crystal cell. If distribution arises in the cel thickness of a liquid crystal cell, it is known in the liquid crystal display that the display engine performance will get worse. Especially in the liquid crystal display in STN (Super Twisted Nematic) mode, it is known that the permeability of light will change with change of $\Delta n \cdot d$ value (however, Δn the rate of a birefringence of liquid crystal and d cel thickness), and since distribution will occur in light transmittance, i.e., brightness, if distribution of the $\Delta n \cdot d$ value change d , i.e., cel thickness, is large, contrast falls. Although losing peculiar yellow and blue coloring with a phase contrast plate, and compensating black and white in STN mode will be performed if distribution of the $\Delta n \cdot d$ value change d , i.e., cel thickness, is large, at this time, an optical property will get worse and an irregular color will arise in a display. Moreover, if the cel thickness d has distribution, the steepness of liquid crystal will get worse and contrast will fall. Thus, since contrast gets worse and an irregular color occurs in a display when distribution arises in the cel thickness d , there is a problem that display quality deteriorates.

[0025] Then, this invention solves the above-mentioned trouble and it aims at offering the manufacture approach of the liquid crystal display which enables equalization of the cel thickness of a liquid crystal cell in the manufacture approach of the liquid crystal display which consists of an ingredient with which the substrate which pinches a liquid crystal layer differs from an opposite substrate. Moreover, it aims at offering the electronic equipment which was excellent in display quality by having this liquid crystal display further for the purpose of offering the liquid crystal display which was excellent in display quality by this manufacture approach.

[0026]

[Means for Solving the Problem] Adhesives are minded on the outside surface of the substrate with a coefficient of thermal expansion large in order to solve the above-mentioned technical problem, as a result of this invention person's inquiring among the substrate which pinches a liquid crystal layer, and an opposite substrate. After sticking the monotonous member which has a different predetermined coefficient of thermal expansion from the coefficient of thermal expansion of this substrate and heating beyond predetermined temperature, by returning to ordinary temperature It found out that the cel thickness of a liquid crystal cell could be equalized by it incurvating a header, a substrate, and an opposite substrate in the same configuration that this substrate and this monotonous member can be incurvated in a predetermined configuration.

[0027] The curve approach of the substrate which this invention person found out is explained.

[0028] if it returns to ordinary temperature after sticking the monotonous member which has a different predetermined coefficient of thermal expansion from the coefficient of thermal expansion of this substrate through adhesives on the outside surface of a substrate with a large coefficient of thermal expansion and heating beyond predetermined temperature -- the one where the one among this substrate and this monotonous member where a coefficient of thermal expansion is larger is smaller -- a temperature up -- large -- expanding -- a temperature fall -- ** -- it contracts greatly.

[0029] Therefore, when the coefficient of thermal expansion of a monotonous member is smaller than the coefficient of thermal expansion of a substrate, a substrate and a monotonous member curve so that a monotonous member side may become a convex. On the other hand, when the coefficient of thermal expansion of a monotonous member is larger than the coefficient of thermal expansion of a substrate, a substrate and a monotonous member curve so that a substrate side may become a convex.

[0030] Thus, since a substrate can be beforehand incurvated in the configuration as a small substrate where another [which curves in the formation process of a sealant by controlling the difference of the coefficient of thermal expansion of a substrate and a monotonous member] coefficient of thermal expansion is the same, the cel thickness of a liquid crystal cell can be equalized.

[0031] Namely, the means which this invention provided in order to solve the above-mentioned technical problem In the manufacture approach of the liquid crystal equipment which consists of an ingredient with which two substrates which were stuck at the predetermined spacing through the sealant in the periphery section, which pinch a liquid crystal layer, and which counter differ After sticking the monotonous member which has a different predetermined coefficient of thermal expansion from this substrate through adhesives on the outside surface of the substrate with a large coefficient of thermal expansion between said two substrates which counter and heating beyond predetermined temperature, by returning to ordinary temperature After incurvating this

substrate and this monotonous member in a predetermined configuration, it is characterized by sticking this substrate and said another substrate through said sealant.

[0032] According to this means, the manufacture approach of the liquid crystal equipment which can equalize spacing (cell thickness of a liquid crystal cell) with another [which curves in the formation process of a sealant] substrate can be offered by incurvating beforehand the substrate with a large coefficient of thermal expansion between two substrates which pinch a liquid crystal layer and which counter in a predetermined configuration.

[0033] Moreover, it sets to the liquid crystal equipment which consists of an ingredient with which two substrates which were stuck at the predetermined spacing through the sealant by this means in the periphery section, which pinch a liquid crystal layer, and which counter differ. Adhesives are minded on the outside surface of the substrate with a large coefficient of thermal expansion between said two substrates which counter. The monotonous member which has a different predetermined coefficient of thermal expansion from this substrate is stuck, and the liquid crystal equipment which is characterized by this substrate, this monotonous member, and said another substrate curving in a predetermined configuration and which was excellent in display quality can be offered.

[0034] Moreover, the electronic equipment which was excellent in display quality can be offered by having this liquid crystal equipment.

[0035] In the above means, when said monotonous member is what has a coefficient of thermal expansion smaller than the coefficient of thermal expansion of said substrate, it is characterized by incurvating said substrate and said monotonous member so that this monotonous member side may become a convex. When said monotonous member is what has a larger coefficient of thermal expansion than the coefficient of thermal expansion of said substrate, it is characterized by incurvating said substrate and said monotonous member so that this substrate side may become a convex.

[0036] It is desirable for the difference of the coefficient of thermal expansion of said substrate and said monotonous member to be equal to the difference of the coefficient of thermal expansion of another [said] substrate and said substrate in the case of which. Said substrate which stuck said monotonous member can be incurvated in the same configuration as another substrate by making the difference of the coefficient of thermal expansion of said substrate and said monotonous member equal to the difference of the coefficient of thermal expansion of another [said] substrate and said substrate.

[0037] Moreover, as for said adhesives, it is desirable to consist of the same ingredient as said sealant. Said substrate which stuck said monotonous member can be incurvated in the same configuration as another substrate by using said adhesives as the same ingredient as said sealant, and hardening these adhesives on the conditions which harden this sealant.

[0038]

[Embodiment of the Invention] Next, the operation gestalt concerning this invention is explained to a detail.

[0039] 1st operation gestalt drawing 1 (a) Process drawing showing the manufacture approach of the reflective mold liquid crystal display 10 using the MOSFET (METARUOKISAI DOSHIRIKON field emission transistor) component 20 as a switching element of the 1st operation gestalt concerning this invention is shown in - (e), and this manufacture approach is explained to it. Drawing 1 (a) - (e) shows the outline sectional view.

[0040] In this operation gestalt, the substrate (bottom substrate) 11 which pinches the liquid crystal layer 13, and a different substrate as opposite substrates (top substrate) 12 are used, and the direction of the coefficient of thermal expansion of the opposite substrate 12 is smaller than the coefficient of thermal expansion of a substrate 11. For example, the substrate which consists of single crystal silicon and glass, respectively is used as a substrate 11 and an opposite substrate 12. Moreover, in the formation process of the sealant 14 which sticks a substrate 11 and the opposite substrate 12, the opposite substrate 12 shall curve so that an internal-surface side (liquid crystal layer 13 side) may become a convex.

[0041] As shown in drawing 1 (a), on the internal surface (illustration top front face) of a substrate 11, the MOSFET component 20 for driving the pixel electrode (reflector) 15 which consists of aluminum which reflects light, and each pixel electrode 15 etc. is formed, and the orientation film 18 is formed on the pixel electrode 15 and the MOSFET component 20.

[0042] The top view which expanded the situation when seeing the substrate 11 before forming the orientation film 18 in drawing 2 from a top is shown. Drawing 1 R> 1 (a) is a sectional view shown along with the A-A' line of drawing 2.

[0043] As shown in drawing 2, on the substrate 11, the scanning line 22 and the data line 16 are arranged in the

shape of a matrix, each pixel is arranged according to the intersection of the scanning line 22 and the data line 16, and the MOSFET component 20 for driving the pixel electrode 15 and each pixel electrode 15 to each pixel is formed. About detailed explanation of the MOSFET component 20, it mentions later.

[0044] Next, as shown in drawing 1 (b), monotonous member 11A which has a predetermined coefficient of thermal expansion which is different in a substrate 11 is stuck through thermosetting adhesive or photoresist adhesives on the outside surface (illustration bottom front face) of a substrate 11. At this time, monotonous member 11A is selected so that the coefficient of thermal expansion of monotonous member 11A may become smaller than the coefficient of thermal expansion of a substrate 11. Moreover, it is desirable to set up so that the difference of the coefficient of thermal expansion of the opposite substrate 12 and a substrate 11 and the difference of the coefficient of thermal expansion of a substrate 11 and monotonous member 11A may become equal. Monotonous member 11A may consist of same ingredients as the opposite substrate 12.

[0045] When the adhesives which stuck a substrate 11 and monotonous member 11A are thermosetting adhesive, adhesives are hardened by heating at about 100-160 degrees C. Moreover, when the used adhesives are photoresist adhesives, adhesives are hardened by irradiating ultraviolet rays etc. An ultraviolet ray lamp is used for hardening of photoresist adhesives, and a temperature up is carried out to about 80 degrees C by generation of heat of an ultraviolet ray lamp. Moreover, when which adhesives are used, after hardening reaction termination lowers temperature to ordinary temperature.

[0046] When the used adhesives are any of thermosetting adhesive and photoresist adhesives, a substrate 11 and monotonous member 11A are heated by the temperature of about 100-160 degrees C or about 80 degrees C. this time -- monotonous member 11A with a substrate 11 and the substrate 11 with a large coefficient of thermal expansion among opposite substrate 11A small [a coefficient of thermal expansion] -- a temperature up -- large -- expanding -- a temperature fall -- ** -- it contracts greatly.

[0047] Consequently, as shown in drawing 1 (c), a substrate 11 and monotonous member 11A curve so that the monotonous member 11A side may become a convex.

[0048] Next, as shown in drawing 1 (d), the common electrode 17 and the orientation film 19 stick the opposite substrate 12 by which sequential formation was carried out, and a substrate 11 at the predetermined spacing through sealant 14A which is not hardened [which consists of thermosetting adhesive or photoresist adhesives] on an internal surface.

[0049] Next, as shown in drawing 1 (e), sealant 14A is hardened and a sealant 14 is formed. When sealant 14A is thermosetting adhesive, adhesives are hardened by heating at about 100-160 degrees C. Moreover, when sealant 14A is photoresist adhesives, adhesives are hardened by irradiating ultraviolet rays etc. An ultraviolet ray lamp is used for hardening of photoresist adhesives, and a temperature up is carried out to about 80 degrees C by generation of heat of an ultraviolet ray lamp. Moreover, when which adhesives are used, after hardening reaction termination lowers temperature to ordinary temperature.

[0050] When the adhesives used as sealant 14A are any of thermosetting adhesive and photoresist adhesives, a substrate 11 and monotonous member 11A are heated by the temperature of 100-160 degrees C or about 80 degrees C. At this time, since the coefficient of thermal expansion of the opposite substrate 12 is smaller than the coefficient of thermal expansion of a substrate 11, thermal expansion of the small opposite substrate 12 is carried out more greatly than a substrate 11. However, since the periphery section of the opposite substrate 12 is being fixed by sealant 14A or 14, the opposite substrate 12 curves so that an internal-surface side may become a convex.

[0051] Finally, the liquid crystal layer 13 is enclosed between a substrate 11 and the opposite substrate 12, and by illustration, although omitted, a phase contrast plate and a polarizing plate are installed in the outside of monotonous member 11A and the opposite substrate 12, and a liquid crystal display 10 is manufactured.

[0052] Here, the detail of the MOSFET (METARUOKISAIDOSHIRIKON field emission transistor) component 20 is explained.

[0053] In order to show the detail of the MOSFET component 20 in drawing 3 , the sectional view shown along with the B-B' line of drawing 2 is shown.

[0054] The well field 21 is formed on a substrate 11, and the field oxide 23 for isolation is formed on the well field 21. Opening is formed in field oxide 23, gate oxide 24 is formed in the center of the inside of this opening, gate electrode 22a and the scanning line 22 are formed in gate oxide 24 front face, and the 1st interlayer insulation film 25 is formed on it. A contact hole 26 is formed in source field 42a, thereby, opening of the 1st interlayer insulation film 25 is carried out, the data line 16 is formed here, and connection with source field 42a

is achieved. Moreover, after the data line 16 is formed, the 2nd interlayer insulation film 27 is formed further. A contact hole 28 is formed in drain field 42b, thereby, the 1st interlayer insulation film 25 and the 2nd interlayer insulation film 27 carry out opening, the pixel electrode 15 is formed here, and connection with drain field 42b is achieved. Moreover, between the 1st interlayer insulation film 25 and the 2nd interlayer insulation film 27, the conductive layer 29 for capacity are recording is formed.

[0055] In this operation gestalt, although the liquid crystal display with the coefficient of thermal expansion of the opposite substrate 12 smaller than the coefficient of thermal expansion of a substrate 11 among a substrate 11 and the opposite substrate 12 was explained This invention is not limited to this and its ** with the coefficient of thermal expansion of a substrate 11 smaller than the coefficient of thermal expansion of the opposite substrate 12 is also good. In that case What is necessary is to stick monotonous member 11A which has a coefficient of thermal expansion smaller than the coefficient of thermal expansion of the opposite substrate 12 on the outside surface of the opposite substrate 12, and just to curve so that the monotonous member 11A side may become a convex about the opposite substrate 12 and monotonous member 11A.

[0056] According to this operation gestalt, a substrate 11 can be curved in a predetermined configuration by sticking monotonous member 11A which has the predetermined coefficient of thermal expansion from which a coefficient of thermal expansion differs on the outside surface of a substrate 11, carrying out a temperature up beyond predetermined temperature, and returning to ordinary temperature.

[0057] In this operation gestalt, it is desirable to set up so that the difference of the coefficient of thermal expansion of the opposite substrate 12 and a substrate 11 and the difference of the coefficient of thermal expansion of a substrate 11 and monotonous member 11A may become equal. Moreover, it is desirable to use the adhesives same as adhesives which stick a substrate 11 and monotonous member 11A as sealant 14A.

[0058] A substrate 11 and the opposite substrate 12 can be incurvated in the same configuration by setting up so that the difference of the coefficient of thermal expansion of the opposite substrate 12 and a substrate 11 and the difference of the coefficient of thermal expansion of a substrate 11 and monotonous member 11A may become equal, and hardening adhesives under the same conditions using the adhesives same as adhesives which stick a substrate 11 and monotonous member 11A as sealant 14A.

[0059] Thus, according to this operation gestalt, since it can curve in the same configuration as the opposite substrate 12 which curves a substrate 11 in the formation process of a sealant 14, the cel thickness of a liquid crystal cell is equalized and the manufacture approach of a liquid crystal display and liquid crystal display which were excellent in display quality can be offered.

[0060] Moreover, in this operation gestalt, although the reflective mold liquid crystal display was explained, this invention is not limited to a reflective mold and can apply a transparency mold, a reflective transfective type, etc. to any liquid crystal equipments. In addition, this operation gestalt is effective in especially the liquid crystal display for projection mold liquid crystal displays that cannot arrange a spacer.

[0061] Process drawing showing the manufacture approach of the reflective mold liquid crystal display 30 using an MOSFET component as a switching element of the 2nd operation gestalt concerning this invention is shown in 2nd operation gestalt drawing 4 , and the manufacture approach is explained to it. In drawing 4 , the same reference mark is given to the same component as a liquid crystal display 10.

[0062] In this operation gestalt, the substrate (bottom substrate) 31 which pinches the liquid crystal layer 13, and a different substrate as opposite substrates (top substrate) 32 are used, the direction of the coefficient of thermal expansion of the opposite substrate 32 becomes smaller than the coefficient of thermal expansion of a substrate 31, and it is small. For example, the substrate which consists of single crystal silicon and glass, respectively is used as a substrate 31 and an opposite substrate 32. Moreover, in the formation process of the sealant 14 which sticks a substrate 31 and the opposite substrate 32, the opposite substrate 32 shall curve so that an outside-surface side may become a convex.

[0063] As shown in drawing 4 (a), on the internal surface (illustration top front face) of a substrate 31, the MOSFET component 20 for driving the pixel electrode (reflector) 15 which consists of aluminum which reflects light like the 1st operation gestalt, and each pixel electrode 15 etc. is formed.

[0064] Since the detailed structure of the top view which expanded the situation when seeing the substrate 31 before forming the orientation film 18 from a top, and the MOSFET component 20 is the same as that of what was shown by drawing 2 and drawing 3 , explanation is omitted.

[0065] Next, as shown in drawing 4 (b), monotonous member 31A which has a predetermined coefficient of thermal expansion which is different in a substrate 31 is stuck through thermosetting adhesive or photoresist

adhesives on the outside surface (illustration bottom front face) of a substrate 31. At this time, monotonous member 31A is selected so that the coefficient of thermal expansion of monotonous member 31A may become larger than the coefficient of thermal expansion of a substrate 31. Moreover, it is desirable to set up so that the difference of the coefficient of thermal expansion of the opposite substrate 32 and a substrate 31 and the difference of the coefficient of thermal expansion of a substrate 31 and monotonous member 31A may become equal.

[0066] When the adhesives which stuck a substrate 31 and monotonous member 31A are thermosetting adhesive, adhesives are hardened by heating at about 100-160 degrees C. Moreover, when the used adhesives are photoresist adhesives, adhesives are hardened by irradiating ultraviolet rays etc. An ultraviolet ray lamp is used for hardening of photoresist adhesives, and a temperature up is carried out to about 80 degrees C by generation of heat of an ultraviolet ray lamp. Moreover, when which adhesives are used, after hardening reaction termination lowers temperature to ordinary temperature.

[0067] When the used adhesives are any of thermosetting adhesive and photoresist adhesives, a substrate 31 and monotonous member 31A are heated by the temperature of about 100-160 degrees C or about 80 degrees C. this time -- monotonous member 31A with a large coefficient of thermal expansion among a substrate 31 and monotonous member 31A -- the substrate 31 with a small coefficient of thermal expansion -- a temperature up - - large -- expanding -- a temperature fall -- ** -- it contracts greatly.

[0068] Consequently, as shown in drawing 4 (c), a substrate 31 and monotonous member 31A curve so that a substrate 31 side may become a convex.

[0069] Next, as shown in drawing 4 (d), the common electrode 17 and the orientation film 19 stick the opposite substrate 32 by which sequential formation was carried out, and a substrate 31 at the predetermined spacing through sealant 14A which is not hardened [which consists of thermosetting adhesive or photoresist adhesives] on an internal surface.

[0070] Next, as shown in drawing 4 (e), sealant 14A is hardened and a sealant 14 is formed. When sealant 14A is thermosetting adhesive, adhesives are hardened by heating at about 100-160 degrees C. Moreover, when sealant 14A is photoresist adhesives, adhesives are hardened by irradiating ultraviolet rays etc. An ultraviolet ray lamp is used for hardening of photoresist adhesives, and a temperature up is carried out to about 80 degrees C by generation of heat of an ultraviolet ray lamp. Moreover, when which adhesives are used, after hardening reaction termination lowers temperature to ordinary temperature.

[0071] When the adhesives used as sealant 14A are any of thermosetting adhesive and photoresist adhesives, a substrate 31 and monotonous member 31A are heated by the temperature of about 100-160 degrees C or about 80 degrees C. At this time, since the coefficient of thermal expansion of the opposite substrate 32 is smaller than the coefficient of thermal expansion of a substrate 31, thermal expansion of the substrate 31 is carried out more greatly than the opposite substrate 32. However, since the periphery section of the opposite substrate 32 is being fixed by sealant 14A or 14, the opposite substrate 32 curves so that an outside-surface side may become a convex.

[0072] Finally, the liquid crystal layer 13 is enclosed between a substrate 31 and the opposite substrate 32, and by illustration, although omitted, a phase contrast plate and a polarizing plate are installed in the outside of monotonous member 31A and the opposite substrate 32, and a liquid crystal display 30 is manufactured.

[0073] In this operation gestalt, although the liquid crystal display with the coefficient of thermal expansion of the opposite substrate 32 smaller than the coefficient of thermal expansion of a substrate 31 among a substrate 31 and the opposite substrate 32 was explained This invention may not be limited to this and its coefficient of thermal expansion of the opposite substrate 32 may be larger than the coefficient of thermal expansion of a substrate 31. In that case What is necessary is to stick monotonous member 31A which has a larger coefficient of thermal expansion than the coefficient of thermal expansion of the opposite substrate 32 on the outside surface of the opposite substrate 32, and just to curve so that the opposite substrate 32 side may become a convex about the opposite substrate 32 and monotonous member 31A.

[0074] According to this operation gestalt, a substrate 31 can be curved in a predetermined configuration by sticking monotonous member 31A which has the predetermined coefficient of thermal expansion from which a coefficient of thermal expansion differs on the outside surface of a substrate 31, carrying out a temperature up beyond predetermined temperature, and returning to ordinary temperature.

[0075] In this operation gestalt, it is desirable to set up so that the difference of the coefficient of thermal expansion of the opposite substrate 32 and a substrate 31 and the difference of the coefficient of thermal

expansion of a substrate 31 and monotonous member 31A may become equal. Moreover, it is desirable to use the adhesives same as adhesives which stick a substrate 31 and monotonous member 31A as sealant 14A.

[0076] A substrate 31 and the opposite substrate 32 can be incurvated in the same configuration by setting up so that the difference of the coefficient of thermal expansion of the opposite substrate 32 and a substrate 31 and the difference of the coefficient of thermal expansion of a substrate 31 and monotonous member 31A may become equal, and hardening adhesives under the same conditions using the adhesives same as adhesives which stick a substrate 31 and monotonous member 31A as sealant 14A.

[0077] Thus, according to this operation gestalt, since it can curve in the same configuration as the opposite substrate 32 which curves a substrate 31 in the formation process of a sealant 14, the cel thickness of a liquid crystal cell is equalized and the manufacture approach of a liquid crystal display and liquid crystal display which were excellent in display quality can be offered.

[0078] Moreover, in this operation gestalt, although the reflective mold liquid crystal display was explained, this invention is not limited to a reflective mold and can apply a transparency mold, a reflective transfective type, etc. to any liquid crystal equipments. This operation gestalt is effective in both the liquid crystal display for a projection mold display which cannot arrange a spacer, and the liquid crystal display for direct viewing type liquid crystal displays which arranges a spacer.

[0079] In addition, in the 1st and 2nd operation gestalt, although only the liquid crystal display using an MOSFET component was explained This invention is not what is limited to this. For example, simple matrix type liquid crystal equipment, The liquid crystal equipment using 2 terminal mold component represented by the MIM (Metal-Insulator-Metal) component, It is applicable also to the liquid crystal equipment using 3 terminal mold component represented by the TFT (Thin-Film Transistor) component, and if it is liquid crystal equipment which consists of an ingredient with which two substrates which pinch a liquid crystal layer, and which counter differ, it is applicable to any liquid crystal equipments.

[0080] Next, the example of electronic equipment equipped with the liquid crystal display 10 of the aforementioned 1st and 2nd operation gestalt or either of 30 is explained.

[0081] Drawing 5 (a) is the perspective view having shown an example of a cellular phone. In drawing 5 (a), 40 shows the body of a cellular phone and 41 shows the liquid crystal display section equipped with the aforementioned liquid crystal display 10 or either of 30.

[0082] Drawing 5 (b) is the perspective view having shown an example of pocket mold information processors, such as a word processor and a personal computer. In drawing 5 (b), the liquid crystal display section which 50 equipped with the information processor and 51 equipped with the input sections, such as a keyboard, the liquid crystal display 10 of the above [53 / an information processing body and 52], or either of 30 is shown.

[0083] Drawing 5 (c) is the perspective view having shown an example of wrist watch mold electronic equipment. In drawing 5 (c), 60 shows the body of a clock and 61 shows the liquid crystal display section equipped with the aforementioned liquid crystal display 10 or either of 30.

[0084] Drawing 6 is the outline block diagram showing the important section of the projector (projection mold liquid crystal display) which used the aforementioned liquid crystal display 10 or either of 30 as light modulation equipment.

[0085] This projector S polarization flux of light by which outgoing radiation was carried out from the light source section 71 arranged in accordance with the system optical axis L, the integrator lens 72, the polarization lighting system 70 by which an outline configuration is carried out from the polarization sensing element 73, and the polarization lighting system 70 according to S polarization flux of light reflector 81 The inside of the light reflected from S polarization reflector 81 of a polarization beam splitter 80 and a polarization beam splitter 80 to reflect, High-reflective-liquid-crystal light modulation equipment 85B which modulates the dichroic mirror 82 which separates the component of blue glow (B), and the separated blue glow (B), High-reflective-liquid-crystal light modulation equipment 85R which modulates the dichroic mirror 83 which is made to reflect the component of red light (R) among the flux of lights after blue glow was separated, and is separated, and the separated red light (R), High-reflective-liquid-crystal light modulation equipment 85G which modulate the remaining green light (G) which penetrates a dichroic mirror 83, The light modulated with three high-reflective-liquid-crystal light modulation equipments 85R, 85G, and 85B is compounded by dichroic mirrors 82 and 83 and the polarization beam splitter 80, and it consists of incident light study systems 90 which consist of a projector lens which projects this synthetic light on a screen 91. The aforementioned liquid crystal display 10 or either of 30 is used for the three above-mentioned high-reflective-liquid-crystal light modulation equipments

85R, 85G, and 85B, respectively.

[0086] Drawing 5 (a) Since each electronic equipment shown in - (c) and drawing 6 is equipped with the aforementioned liquid crystal display 10 or either of 30, it becomes what was excellent in display quality.

[0087]

[Effect of the Invention] [as explained above, when it consists of ingredients with which two substrates which pinch a liquid crystal layer, and which counter differ according to this invention] By sticking the monotonous member which has the predetermined coefficient of thermal expansion in which a coefficient of thermal expansion differs from this substrate, carrying out a temperature up beyond predetermined temperature, and returning at ordinary temperature on the outside surface of the substrate with a large coefficient of thermal expansion between two substrates Since this substrate can be incurvated in a predetermined configuration, this substrate can be made into the same configuration as another [which curves in the formation process of a sealant] substrate. The cel thickness of a liquid crystal cell is equalized and the manufacture approach of a liquid crystal display and liquid crystal display which were excellent in display quality can be offered.

[0088] Moreover, the electronic equipment which was excellent in display quality can be offered by having this liquid crystal display.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] This invention relates to electronic equipment equipped with the liquid crystal equipment manufactured by the manufacture approach of the liquid crystal equipment which consists of an ingredient with which two substrates which are applied to the manufacture approach, liquid crystal equipment, and electronic equipment of liquid crystal equipment, especially pinch a liquid crystal layer, and which counter differ, and this manufacture approach, and this liquid crystal equipment.

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PRIOR ART

[Description of the Prior Art] As a liquid crystal display, the direct viewing type liquid crystal display carried in a cellular phone, a pocket mold information processor, etc. and projection mold liquid crystal displays, such as a projector, are known.

[0003] The outline sectional view of the common liquid crystal display 100 used for a direct viewing type liquid crystal display is shown in drawing 7 , and the structure of this liquid crystal display is explained to it.

[0004] As shown in drawing 7 , a substrate (bottom substrate) 101 and the opposite substrate (top substrate) 102 are stuck at intervals of predetermined through a sealant 104 in each periphery section, and the liquid crystal layer 103 is enclosed between the substrate 101 and the opposite substrate 102. On the inside of a substrate 101 and the opposite substrate 102, transparent electrodes 105 and 106 are formed by the predetermined pattern, respectively, and the orientation film 107 and 108 is formed on a transparent electrode 105 and 106.

[0005] Although a phase contrast plate and a polarizing plate are installed in the outside of a substrate 101 and the opposite substrate 102, it is omitting in illustration.

[0006] In the liquid crystal display 100, in order to keep constant spacing (cell thickness of a liquid crystal cell) of a substrate 101 and the opposite substrate 102, many spherical spacers 109 which consist of a silicon dioxide, polystyrene, etc. are arranged between the substrate 101 and the opposite substrate 102.

[0007] Next, the outline sectional view of the common liquid crystal display 200 used for a projection mold liquid crystal display is shown in drawing 8 , and the structure of this liquid crystal display is explained to it. In drawing 8 , the same reference number is given to the same component as a liquid crystal display 100, and explanation is omitted.

[0008] In a liquid crystal display 200, since a spacer is also expanded and displayed when the spacer has been arranged between a substrate 101 and the opposite substrate 102 in order to display by carrying out expansion projection of the liquid crystal panel, optical leakage arises into the part and there is a problem of reducing display quality. Therefore, in a liquid crystal display 200, as shown in drawing 8 , a spacer cannot be arranged between a substrate 101 and the opposite substrate 102.

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EFFECT OF THE INVENTION

[Effect of the Invention] [as explained above, when it consists of ingredients with which two substrates which pinch a liquid crystal layer, and which counter differ according to this invention] By sticking the monotonous member which has the predetermined coefficient of thermal expansion in which a coefficient of thermal expansion differs from this substrate, carrying out a temperature up beyond predetermined temperature, and returning at ordinary temperature on the outside surface of the substrate with a large coefficient of thermal expansion between two substrates Since this substrate can be incurvated in a predetermined configuration, this substrate can be made into the same configuration as another [which curves in the formation process of a sealant] substrate. The cel thickness of a liquid crystal cell is equalized and the manufacture approach of a liquid crystal display and liquid crystal display which were excellent in display quality can be offered. [0088] Moreover, the electronic equipment which was excellent in display quality can be offered by having this liquid crystal display.

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In a common liquid crystal display as shown with the above-mentioned liquid crystal display 100,200, although the same substrate is usually used as a substrate 101 and an opposite substrate 102, a different substrate may be used.

[0010] The reflective mold liquid crystal display 300 with which a different substrate is used as a substrate 101 and an opposite substrate 102 and which is used for a projection mold display as an example at drawing 9 is shown, and the structure of this liquid crystal display is explained. In drawing 9, the same reference number is given to the same component as a liquid crystal display 200, and explanation is omitted.

[0011] On the substrate 101, many reflectors 305 which consist of aluminum which reflects light are formed in the shape of a matrix, and the switching element for driving each reflector 305 is prepared. The orientation film 107 is formed on the reflector 305 and the switching element.

[0012] In this liquid crystal display 300, the light which carried out incidence into the liquid crystal panel from the outside of the opposite substrate 102 passes the liquid crystal layer 103, it is reflected on reflector 305 front face, and it passes the opposite substrate 102, and is emitted to the exterior of a liquid crystal panel.

[0013] In this liquid crystal display 300, when a substrate 101 consists of single crystal ingredients, such as single crystal silicon, and the switching element is formed on this single crystal substrate, the reflector 305 formed on a substrate 101 can be switched to a high speed rather than the time of consisting of a switching element formed on amorphous materials, such as glass.

[0014] Since the light reflected with the reflector 305 passes the opposite substrate 102 on the other hand, it is emitted to the exterior of a liquid crystal display 300 and a display is performed, it is needed that the opposite substrate 102 is transparent. Therefore, opaque single crystal silicon etc. cannot be used as an opposite substrate 102.

[0015] Therefore, since the substrate which consists of single crystal ingredients, such as single crystal silicon, as a substrate 101 is used and the substrate which consists of transparent materials, such as glass, as an opposite substrate 102 is used when forming a transistor on the case where the high-speed response of the reflective mold liquid crystal display 300 is carried out, or a substrate 101, the substrate which consists of a different ingredient as a substrate 101 and an opposite substrate 102 is used.

[0016] In the liquid crystal display 300 with which a different substrate is used as a substrate 101 and an opposite substrate 102, in the production process of a liquid crystal display 300, in case a sealant 104 is formed, it has the trouble of producing cel thickness nonuniformity between a substrate 101 and the opposite substrate 102.

[0017] A sealant 104 applies thermosetting adhesive or photoresist adhesives between the periphery sections of a substrate 101 and the opposite substrate 102, and is formed by hardening adhesives. In the case of thermosetting adhesive, hardening of adhesives is performed by usually heating at about 100-160 degrees C, and, in the case of photoresist adhesives, is performed by irradiating ultraviolet rays etc. In the case of photoresist adhesives, heating is not performed, but it is generation of heat from that of an ultraviolet ray lamp, and a temperature up is carried out to about 80 degrees C.

[0018] Therefore, as a sealant 104, when using any of thermosetting adhesive and photoresist adhesives, a liquid crystal cell is heated by about 100-160 degrees C or about 80 degrees C.

[0019] Since a different substrate as a substrate 101 and an opposite substrate 102 is used in that case, the coefficients of thermal expansion of a substrate 101 and the opposite substrate 102 differ, and a substrate with a large coefficient of thermal expansion expands greatly with a temperature rise as compared with a substrate with a small coefficient of thermal expansion. Furthermore, since the periphery section of a substrate is being

fixed by the sealant 104, a curve arises in the substrate which expanded.

[0020] For example, when single crystal silicon and the opposite substrate 102 consist [a substrate 101] of glass, it curves so that the internal-surface side of the opposite substrate 102 may become a convex, or since the coefficient of thermal expansion is larger than glass, as the direction of single crystal silicon shows the opposite substrate 102 to drawing 10 (a), as shown in drawing 10 $R > 0$ (b), it curves so that the outside-surface side of the opposite substrate 102 may become a convex. When the opposite substrate 102 is level, the gap from from is the most remarkable also in curve [which / of the opposite substrate 102 shown in drawing 10 (a) and (b)] in the center section of the opposite substrate 102. For example, as for gap g in the center section of the opposite substrate 102, the thickness of 0.6×10^{-6} m and the opposite substrate 102 is about 1×10^{-6} m, when the thickness of a substrate 101 is 0.7×10^{-6} to 3 m. Therefore, there is a trouble that distribution of an about [1×10^{-6} m] arises also in the thickness (cel thickness of a liquid crystal cell) of the liquid crystal layer 103 pinched by a substrate 101 and the opposite substrate 102. Since the cel thickness of a liquid crystal cell is about $3-6 \times 10^{-6}$ m, this gap is large.

[0021] If the above problem is a liquid crystal display which consists of a substrate with which a substrate 101 differs from the opposite substrate 102 instead of the problem restricted to the reflective mold liquid crystal display 300 for a projection mold display, it is a problem produced in any liquid crystal displays.

[0022] In the common liquid crystal display 100 for direct viewing type liquid crystal displays which arranges a spacer 109, although the curve of the opposite substrate 102 shown by drawing 10 (a) can be prevented, even if it arranges a spacer 109, the curve of the opposite substrate 102 shown by drawing 10 (b) cannot be prevented.

[0023] Moreover, neither of the curves of the opposite substrates 102 shown by drawing 10 (a) and drawing 10 (b) can be prevented, but a problem is remarkable in the common liquid crystal display 200 (300 is included) for projection mold liquid crystal displays which does not arrange a spacer.

[0024] Here, a problem in case distribution arises is explained to the cel thickness of a liquid crystal cell. If distribution arises in the cel thickness of a liquid crystal cell, it is known in the liquid crystal display that the display engine performance will get worse. Especially in the liquid crystal display in STN (Super Twisted Nematic) mode, it is known that the permeability of light will change with change of $\Delta n \cdot d$ value (however, Δn the rate of a birefringence of liquid crystal and d cel thickness), and since distribution will occur in light transmittance, i.e., brightness, if distribution of the $\Delta n \cdot d$ value change d , i.e., cel thickness, is large, contrast falls. Although losing peculiar yellow and blue coloring with a phase contrast plate, and compensating black and white in STN mode will be performed if distribution of the $\Delta n \cdot d$ value change d , i.e., cel thickness, is large, at this time, an optical property will get worse and an irregular color will arise in a display. Moreover, if the cel thickness d has distribution, the steepness of liquid crystal will get worse and contrast will fall. Thus, since contrast gets worse and an irregular color occurs in a display when distribution arises in the cel thickness d , there is a problem that display quality deteriorates.

[0025] Then, this invention solves the above-mentioned trouble and it aims at offering the manufacture approach of the liquid crystal display which enables equalization of the cel thickness of a liquid crystal cell in the manufacture approach of the liquid crystal display which consists of an ingredient with which the substrate which pinches a liquid crystal layer differs from an opposite substrate. Moreover, it aims at offering the electronic equipment which was excellent in display quality by having this liquid crystal display further for the purpose of offering the liquid crystal display which was excellent in display quality by this manufacture approach.

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MEANS

[Means for Solving the Problem] Adhesives are minded on the outside surface of the substrate with a coefficient of thermal expansion large in order to solve the above-mentioned technical problem, as a result of this invention person's inquiring among the substrate which pinches a liquid crystal layer, and an opposite substrate. After sticking the monotonous member which has a different predetermined coefficient of thermal expansion from the coefficient of thermal expansion of this substrate and heating beyond predetermined temperature, by returning to ordinary temperature It found out that the cel thickness of a liquid crystal cell could be equalized by it incurvating a header, a substrate, and an opposite substrate in the same configuration that this substrate and this monotonous member can be incurvated in a predetermined configuration.

[0027] The curve approach of the substrate which this invention person found out is explained.

[0028] if it returns to ordinary temperature after sticking the monotonous member which has a different predetermined coefficient of thermal expansion from the coefficient of thermal expansion of this substrate through adhesives on the outside surface of a substrate with a large coefficient of thermal expansion and heating beyond predetermined temperature -- the one where the one among this substrate and this monotonous member where a coefficient of thermal expansion is larger is smaller -- a temperature up -- large -- expanding -- a temperature fall -- ** -- it contracts greatly.

[0029] Therefore, when the coefficient of thermal expansion of a monotonous member is smaller than the coefficient of thermal expansion of a substrate, a substrate and a monotonous member curve so that a monotonous member side may become a convex. On the other hand, when the coefficient of thermal expansion of a monotonous member is larger than the coefficient of thermal expansion of a substrate, a substrate and a monotonous member curve so that a substrate side may become a convex.

[0030] Thus, since a substrate can be beforehand incurvated in the configuration as a small substrate where another [which curves in the formation process of a sealant by controlling the difference of the coefficient of thermal expansion of a substrate and a monotonous member] coefficient of thermal expansion is the same, the cel thickness of a liquid crystal cell can be equalized.

[0031] Namely, the means which this invention provided in order to solve the above-mentioned technical problem In the manufacture approach of the liquid crystal equipment which consists of an ingredient with which two substrates which were stuck at the predetermined spacing through the sealant in the periphery section, which pinch a liquid crystal layer, and which counter differ After sticking the monotonous member which has a different predetermined coefficient of thermal expansion from this substrate through adhesives on the outside surface of the substrate with a large coefficient of thermal expansion between said two substrates which counter and heating beyond predetermined temperature, by returning to ordinary temperature After incurvating this substrate and this monotonous member in a predetermined configuration, it is characterized by sticking this substrate and said another substrate through said sealant.

[0032] According to this means, the manufacture approach of the liquid crystal equipment which can equalize spacing (cel thickness of a liquid crystal cell) with another [which curves in the formation process of a sealant] substrate can be offered by incurvating beforehand the substrate with a large coefficient of thermal expansion between two substrates which pinch a liquid crystal layer and which counter in a predetermined configuration.

[0033] Moreover, it sets to the liquid crystal equipment which consists of an ingredient with which two substrates which were stuck at the predetermined spacing through the sealant by this means in the periphery section, which pinch a liquid crystal layer, and which counter differ. Adhesives are minded on the outside surface of the substrate with a large coefficient of thermal expansion between said two substrates which counter. The monotonous member which has a different predetermined coefficient of thermal expansion from

this substrate is stuck, and the liquid crystal equipment which is characterized by this substrate, this monotonous member, and said another substrate curving in a predetermined configuration and which was excellent in display quality can be offered.

[0034] Moreover, the electronic equipment which was excellent in display quality can be offered by having this liquid crystal equipment.

[0035] In the above means, when said monotonous member is what has a coefficient of thermal expansion smaller than the coefficient of thermal expansion of said substrate, it is characterized by incurvating said substrate and said monotonous member so that this monotonous member side may become a convex. When said monotonous member is what has a larger coefficient of thermal expansion than the coefficient of thermal expansion of said substrate, it is characterized by incurvating said substrate and said monotonous member so that this substrate side may become a convex.

[0036] It is desirable for the difference of the coefficient of thermal expansion of said substrate and said monotonous member to be equal to the difference of the coefficient of thermal expansion of another [said] substrate and said substrate in the case of which. Said substrate which stuck said monotonous member can be incurvated in the same configuration as another substrate by making the difference of the coefficient of thermal expansion of said substrate and said monotonous member equal to the difference of the coefficient of thermal expansion of another [said] substrate and said substrate.

[0037] Moreover, as for said adhesives, it is desirable to consist of the same ingredient as said sealant. Said substrate which stuck said monotonous member can be incurvated in the same configuration as another substrate by using said adhesives as the same ingredient as said sealant, and hardening these adhesives on the conditions which harden this sealant.

[0038]

[Embodiment of the Invention] Next, the operation gestalt concerning this invention is explained to a detail.

[0039] 1st operation gestalt drawing 1 (a) Process drawing showing the manufacture approach of the reflective mold liquid crystal display 10 using the MOSFET (METARUOKISAIDOSHIRIKON field emission transistor) component 20 as a switching element of the 1st operation gestalt concerning this invention is shown in - (e), and this manufacture approach is explained to it. Drawing 1 (a) - (e) shows the outline sectional view.

[0040] In this operation gestalt, the substrate (bottom substrate) 11 which pinches the liquid crystal layer 13, and a different substrate as opposite substrates (top substrate) 12 are used, and the direction of the coefficient of thermal expansion of the opposite substrate 12 is smaller than the coefficient of thermal expansion of a substrate 11. For example, the substrate which consists of single crystal silicon and glass, respectively is used as a substrate 11 and an opposite substrate 12. Moreover, in the formation process of the sealant 14 which sticks a substrate 11 and the opposite substrate 12, the opposite substrate 12 shall curve so that an internal-surface side (liquid crystal layer 13 side) may become a convex.

[0041] As shown in drawing 1 (a), on the internal surface (illustration top front face) of a substrate 11, the MOSFET component 20 for driving the pixel electrode (reflector) 15 which consists of aluminum which reflects light, and each pixel electrode 15 etc. is formed, and the orientation film 18 is formed on the pixel electrode 15 and the MOSFET component 20.

[0042] The top view which expanded the situation when seeing the substrate 11 before forming the orientation film 18 in drawing 2 from a top is shown. Drawing 1 R> 1 (a) is a sectional view shown along with the A-A' line of drawing 2.

[0043] As shown in drawing 2, on the substrate 11, the scanning line 22 and the data line 16 are arranged in the shape of a matrix, each pixel is arranged according to the intersection of the scanning line 22 and the data line 16, and the MOSFET component 20 for driving the pixel electrode 15 and each pixel electrode 15 to each pixel is formed. About detailed explanation of the MOSFET component 20, it mentions later.

[0044] Next, as shown in drawing 1 (b), monotonous member 11A which has a predetermined coefficient of thermal expansion which is different in a substrate 11 is stuck through thermosetting adhesive or photoresist adhesives on the outside surface (illustration bottom front face) of a substrate 11. At this time, monotonous member 11A is selected so that the coefficient of thermal expansion of monotonous member 11A may become smaller than the coefficient of thermal expansion of a substrate 11. Moreover, it is desirable to set up so that the difference of the coefficient of thermal expansion of the opposite substrate 12 and a substrate 11 and the difference of the coefficient of thermal expansion of a substrate 11 and monotonous member 11A may become equal. Monotonous member 11A may consist of same ingredients as the opposite substrate 12.

[0045] When the adhesives which stuck a substrate 11 and monotonous member 11A are thermosetting adhesive, adhesives are hardened by heating at about 100-160 degrees C. Moreover, when the used adhesives are photoresist adhesives, adhesives are hardened by irradiating ultraviolet rays etc. An ultraviolet ray lamp is used for hardening of photoresist adhesives, and a temperature up is carried out to about 80 degrees C by generation of heat of an ultraviolet ray lamp. Moreover, when which adhesives are used, after hardening reaction termination lowers temperature to ordinary temperature.

[0046] When the used adhesives are any of thermosetting adhesive and photoresist adhesives, a substrate 11 and monotonous member 11A are heated by the temperature of about 100-160 degrees C or about 80 degrees C. this time -- monotonous member 11A with a substrate 11 and the substrate 11 with a large coefficient of thermal expansion among opposite substrate 11A small [a coefficient of thermal expansion] -- a temperature up -- large -- expanding -- a temperature fall -- ** -- it contracts greatly.

[0047] Consequently, as shown in drawing 1 (c), a substrate 11 and monotonous member 11A curve so that the monotonous member 11A side may become a convex.

[0048] Next, as shown in drawing 1 (d), the common electrode 17 and the orientation film 19 stick the opposite substrate 12 by which sequential formation was carried out, and a substrate 11 at the predetermined spacing through sealant 14A which is not hardened [which consists of thermosetting adhesive or photoresist adhesives] on an internal surface.

[0049] Next, as shown in drawing 1 (e), sealant 14A is hardened and a sealant 14 is formed. When sealant 14A is thermosetting adhesive, adhesives are hardened by heating at about 100-160 degrees C. Moreover, when sealant 14A is photoresist adhesives, adhesives are hardened by irradiating ultraviolet rays etc. An ultraviolet ray lamp is used for hardening of photoresist adhesives, and a temperature up is carried out to about 80 degrees C by generation of heat of an ultraviolet ray lamp. Moreover, when which adhesives are used, after hardening reaction termination lowers temperature to ordinary temperature.

[0050] When the adhesives used as sealant 14A are any of thermosetting adhesive and photoresist adhesives, a substrate 11 and monotonous member 11A are heated by the temperature of 100-160 degrees C or about 80 degrees C. At this time, since the coefficient of thermal expansion of the opposite substrate 12 is smaller than the coefficient of thermal expansion of a substrate 11, thermal expansion of the small opposite substrate 12 is carried out more greatly than a substrate 11. However, since the periphery section of the opposite substrate 12 is being fixed by sealant 14A or 14, the opposite substrate 12 curves so that an internal-surface side may become a convex.

[0051] Finally, the liquid crystal layer 13 is enclosed between a substrate 11 and the opposite substrate 12, and by illustration, although omitted, a phase contrast plate and a polarizing plate are installed in the outside of monotonous member 11A and the opposite substrate 12, and a liquid crystal display 10 is manufactured.

[0052] Here, the detail of the MOSFET (METARUOKISAIDOSHIRIKON field emission transistor) component 20 is explained.

[0053] In order to show the detail of the MOSFET component 20 in drawing 3 , the sectional view shown along with the B-B' line of drawing 2 is shown.

[0054] The well field 21 is formed on a substrate 11, and the field oxide 23 for isolation is formed on the well field 21. Opening is formed in field oxide 23, gate oxide 24 is formed in the center of the inside of this opening, gate electrode 22a and the scanning line 22 are formed in gate oxide 24 front face, and the 1st interlayer insulation film 25 is formed on it. A contact hole 26 is formed in source field 42a, thereby, opening of the 1st interlayer insulation film 25 is carried out, the data line 16 is formed here, and connection with source field 42a is achieved. Moreover, after the data line 16 is formed, the 2nd interlayer insulation film 27 is formed further. A contact hole 28 is formed in drain field 42b, thereby, the 1st interlayer insulation film 25 and the 2nd interlayer insulation film 27 carry out opening, the pixel electrode 15 is formed here, and connection with drain field 42b is achieved. Moreover, between the 1st interlayer insulation film 25 and the 2nd interlayer insulation film 27, the conductive layer 29 for capacity are recording is formed.

[0055] In this operation gestalt, although the liquid crystal display with the coefficient of thermal expansion of the opposite substrate 12 smaller than the coefficient of thermal expansion of a substrate 11 among a substrate 11 and the opposite substrate 12 was explained This invention is not limited to this and its ** with the coefficient of thermal expansion of a substrate 11 smaller than the coefficient of thermal expansion of the opposite substrate 12 is also good. In that case What is necessary is to stick monotonous member 11A which has a coefficient of thermal expansion smaller than the coefficient of thermal expansion of the opposite

substrate 12 on the outside surface of the opposite substrate 12, and just to curve so that the monotonous member 11A side may become a convex about the opposite substrate 12 and monotonous member 11A.

[0056] According to this operation gestalt, a substrate 11 can be curved in a predetermined configuration by sticking monotonous member 11A which has the predetermined coefficient of thermal expansion from which a coefficient of thermal expansion differs on the outside surface of a substrate 11, carrying out a temperature up beyond predetermined temperature, and returning to ordinary temperature.

[0057] In this operation gestalt, it is desirable to set up so that the difference of the coefficient of thermal expansion of the opposite substrate 12 and a substrate 11 and the difference of the coefficient of thermal expansion of a substrate 11 and monotonous member 11A may become equal. Moreover, it is desirable to use the adhesives same as adhesives which stick a substrate 11 and monotonous member 11A as sealant 14A.

[0058] A substrate 11 and the opposite substrate 12 can be incurvated in the same configuration by setting up so that the difference of the coefficient of thermal expansion of the opposite substrate 12 and a substrate 11 and the difference of the coefficient of thermal expansion of a substrate 11 and monotonous member 11A may become equal, and hardening adhesives under the same conditions using the adhesives same as adhesives which stick a substrate 11 and monotonous member 11A as sealant 14A.

[0059] Thus, according to this operation gestalt, since it can curve in the same configuration as the opposite substrate 12 which curves a substrate 11 in the formation process of a sealant 14, the cel thickness of a liquid crystal cell is equalized and the manufacture approach of a liquid crystal display and liquid crystal display which were excellent in display quality can be offered.

[0060] Moreover, in this operation gestalt, although the reflective mold liquid crystal display was explained, this invention is not limited to a reflective mold and can apply a transparency mold, a reflective transfective type, etc. to any liquid crystal equipments. In addition, this operation gestalt is effective in especially the liquid crystal display for projection mold liquid crystal displays that cannot arrange a spacer.

[0061] Process drawing showing the manufacture approach of the reflective mold liquid crystal display 30 using an MOSFET component as a switching element of the 2nd operation gestalt concerning this invention is shown in 2nd operation gestalt drawing 4 , and the manufacture approach is explained to it. In drawing 4 , the same reference mark is given to the same component as a liquid crystal display 10.

[0062] In this operation gestalt, the substrate (bottom substrate) 31 which pinches the liquid crystal layer 13, and a different substrate as opposite substrates (top substrate) 32 are used, the direction of the coefficient of thermal expansion of the opposite substrate 32 becomes smaller than the coefficient of thermal expansion of a substrate 31, and it is small. For example, the substrate which consists of single crystal silicon and glass, respectively is used as a substrate 31 and an opposite substrate 32. Moreover, in the formation process of the sealant 14 which sticks a substrate 31 and the opposite substrate 32, the opposite substrate 32 shall curve so that an outside-surface side may become a convex.

[0063] As shown in drawing 4 (a), on the internal surface (illustration top front face) of a substrate 31, the MOSFET component 20 for driving the pixel electrode (reflector) 15 which consists of aluminum which reflects light like the 1st operation gestalt, and each pixel electrode 15 etc. is formed.

[0064] Since the detailed structure of the top view which expanded the situation when seeing the substrate 31 before forming the orientation film 18 from a top, and the MOSFET component 20 is the same as that of what was shown by drawing 2 and drawing 3 , explanation is omitted.

[0065] Next, as shown in drawing 4 (b), monotonous member 31A which has a predetermined coefficient of thermal expansion which is different in a substrate 31 is stuck through thermosetting adhesive or photoresist adhesives on the outside surface (illustration bottom front face) of a substrate 31. At this time, monotonous member 31A is selected so that the coefficient of thermal expansion of monotonous member 31A may become larger than the coefficient of thermal expansion of a substrate 31. Moreover, it is desirable to set up so that the difference of the coefficient of thermal expansion of the opposite substrate 32 and a substrate 31 and the difference of the coefficient of thermal expansion of a substrate 31 and monotonous member 31A may become equal.

[0066] When the adhesives which stuck a substrate 31 and monotonous member 31A are thermosetting adhesive, adhesives are hardened by heating at about 100-160 degrees C. Moreover, when the used adhesives are photoresist adhesives, adhesives are hardened by irradiating ultraviolet rays etc. An ultraviolet ray lamp is used for hardening of photoresist adhesives, and a temperature up is carried out to about 80 degrees C by generation of heat of an ultraviolet ray lamp. Moreover, when which adhesives are used, after hardening

reaction termination lowers temperature to ordinary temperature.

[0067] When the used adhesives are any of thermosetting adhesive and photoresist adhesives, a substrate 31 and monotonous member 31A are heated by the temperature of about 100-160 degrees C or about 80 degrees C. this time -- monotonous member 31A with a large coefficient of thermal expansion among a substrate 31 and monotonous member 31A -- the substrate 31 with a small coefficient of thermal expansion -- a temperature up - large -- expanding -- a temperature fall -- ** -- it contracts greatly.

[0068] Consequently, as shown in drawing 4 (c), a substrate 31 and monotonous member 31A curve so that a substrate 31 side may become a convex.

[0069] Next, as shown in drawing 4 (d), the common electrode 17 and the orientation film 19 stick the opposite substrate 32 by which sequential formation was carried out, and a substrate 31 at the predetermined spacing through sealant 14A which is not hardened [which consists of thermosetting adhesive or photoresist adhesives] on an internal surface.

[0070] Next, as shown in drawing 4 (e), sealant 14A is hardened and a sealant 14 is formed. When sealant 14A is thermosetting adhesive, adhesives are hardened by heating at about 100-160 degrees C. Moreover, when sealant 14A is photoresist adhesives, adhesives are hardened by irradiating ultraviolet rays etc. An ultraviolet ray lamp is used for hardening of photoresist adhesives, and a temperature up is carried out to about 80 degrees C by generation of heat of an ultraviolet ray lamp. Moreover, when which adhesives are used, after hardening reaction termination lowers temperature to ordinary temperature.

[0071] When the adhesives used as sealant 14A are any of thermosetting adhesive and photoresist adhesives, a substrate 31 and monotonous member 31A are heated by the temperature of about 100-160 degrees C or about 80 degrees C. At this time, since the coefficient of thermal expansion of the opposite substrate 32 is smaller than the coefficient of thermal expansion of a substrate 31, thermal expansion of the substrate 31 is carried out more greatly than the opposite substrate 32. However, since the periphery section of the opposite substrate 32 is being fixed by sealant 14A or 14, the opposite substrate 32 curves so that an outside-surface side may become a convex.

[0072] Finally, the liquid crystal layer 13 is enclosed between a substrate 31 and the opposite substrate 32, and by illustration, although omitted, a phase contrast plate and a polarizing plate are installed in the outside of monotonous member 31A and the opposite substrate 32, and a liquid crystal display 30 is manufactured.

[0073] In this operation gestalt, although the liquid crystal display with the coefficient of thermal expansion of the opposite substrate 32 smaller than the coefficient of thermal expansion of a substrate 31 among a substrate 31 and the opposite substrate 32 was explained This invention may not be limited to this and its coefficient of thermal expansion of the opposite substrate 32 may be larger than the coefficient of thermal expansion of a substrate 31. In that case What is necessary is to stick monotonous member 31A which has a larger coefficient of thermal expansion than the coefficient of thermal expansion of the opposite substrate 32 on the outside surface of the opposite substrate 32, and just to curve so that the opposite substrate 32 side may become a convex about the opposite substrate 32 and monotonous member 31A.

[0074] According to this operation gestalt, a substrate 31 can be curved in a predetermined configuration by sticking monotonous member 31A which has the predetermined coefficient of thermal expansion from which a coefficient of thermal expansion differs on the outside surface of a substrate 31, carrying out a temperature up beyond predetermined temperature, and returning to ordinary temperature.

[0075] In this operation gestalt, it is desirable to set up so that the difference of the coefficient of thermal expansion of the opposite substrate 32 and a substrate 31 and the difference of the coefficient of thermal expansion of a substrate 31 and monotonous member 31A may become equal. Moreover, it is desirable to use the adhesives same as adhesives which stick a substrate 31 and monotonous member 31A as sealant 14A.

[0076] A substrate 31 and the opposite substrate 32 can be incurvated in the same configuration by setting up so that the difference of the coefficient of thermal expansion of the opposite substrate 32 and a substrate 31 and the difference of the coefficient of thermal expansion of a substrate 31 and monotonous member 31A may become equal, and hardening adhesives under the same conditions using the adhesives same as adhesives which stick a substrate 31 and monotonous member 31A as sealant 14A.

[0077] Thus, according to this operation gestalt, since it can curve in the same configuration as the opposite substrate 32 which curves a substrate 31 in the formation process of a sealant 14, the cel thickness of a liquid crystal cell is equalized and the manufacture approach of a liquid crystal display and liquid crystal display which were excellent in display quality can be offered.

[0078] Moreover, in this operation gestalt, although the reflective mold liquid crystal display was explained, this invention is not limited to a reflective mold and can apply a transparency mold, a reflective transfective type, etc. to any liquid crystal equipments. This operation gestalt is effective in both the liquid crystal display for a projection mold display which cannot arrange a spacer, and the liquid crystal display for direct viewing type liquid crystal displays which arranges a spacer.

[0079] In addition, in the 1st and 2nd operation gestalt, although only the liquid crystal display using an MOSFET component was explained This invention is not what is limited to this. For example, simple matrix type liquid crystal equipment, The liquid crystal equipment using 2 terminal mold component represented by the MIM (Metal-Insulator-Metal) component, It is applicable also to the liquid crystal equipment using 3 terminal mold component represented by the TFT (Thin-Film Transistor) component, and if it is liquid crystal equipment which consists of an ingredient with which two substrates which pinch a liquid crystal layer, and which counter differ, it is applicable to any liquid crystal equipments.

[0080] Next, the example of electronic equipment equipped with the liquid crystal display 10 of the aforementioned 1st and 2nd operation gestalt or either of 30 is explained.

[0081] Drawing 5 (a) is the perspective view having shown an example of a cellular phone. In drawing 5 (a), 40 shows the body of a cellular phone and 41 shows the liquid crystal display section equipped with the aforementioned liquid crystal display 10 or either of 30.

[0082] Drawing 5 (b) is the perspective view having shown an example of pocket mold information processors, such as a word processor and a personal computer. In drawing 5 (b), the liquid crystal display section which 50 equipped with the information processor and 51 equipped with the input sections, such as a keyboard, the liquid crystal display 10 of the above [53 / an information processing body and 52], or either of 30 is shown.

[0083] Drawing 5 (c) is the perspective view having shown an example of wrist watch mold electronic equipment. In drawing 5 (c), 60 shows the body of a clock and 61 shows the liquid crystal display section equipped with the aforementioned liquid crystal display 10 or either of 30.

[0084] Drawing 6 is the outline block diagram showing the important section of the projector (projection mold liquid crystal display) which used the aforementioned liquid crystal display 10 or either of 30 as light modulation equipment.

[0085] This projector S polarization flux of light by which outgoing radiation was carried out from the light source section 71 arranged in accordance with the system optical axis L, the integrator lens 72, the polarization lighting system 70 by which an outline configuration is carried out from the polarization sensing element 73, and the polarization lighting system 70 according to S polarization flux of light reflector 81 The inside of the light reflected from S polarization reflector 81 of a polarization beam splitter 80 and a polarization beam splitter 80 to reflect, High-reflective-liquid-crystal light modulation equipment 85B which modulates the dichroic mirror 82 which separates the component of blue glow (B), and the separated blue glow (B), High-reflective-liquid-crystal light modulation equipment 85R which modulates the dichroic mirror 83 which is made to reflect the component of red light (R) among the flux of lights after blue glow was separated, and is separated, and the separated red light (R), High-reflective-liquid-crystal light modulation equipment 85G which modulate the remaining green light (G) which penetrates a dichroic mirror 83, The light modulated with three high-reflective-liquid-crystal light modulation equipments 85R, 85G, and 85B is compounded by dichroic mirrors 82 and 83 and the polarization beam splitter 80, and it consists of incident light study systems 90 which consist of a projector lens which projects this synthetic light on a screen 91. The aforementioned liquid crystal display 10 or either of 30 is used for the three above-mentioned high-reflective-liquid-crystal light modulation equipments 85R, 85G, and 85B, respectively.

[0086] Drawing 5 (a) Since each electronic equipment shown in - (c) and drawing 6 is equipped with the aforementioned liquid crystal display 10 or either of 30, it becomes what was excellent in display quality.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Drawing 1 (a) - (e) is process drawing showing the manufacture approach of the reflective mold liquid crystal display of the 1st operation gestalt concerning this invention.

[Drawing 2] Drawing 2 is the top view expanding and showing the reflective mold liquid crystal display of the 1st operation gestalt concerning this invention.

[Drawing 3] Drawing 3 is the sectional view showing the structure of the TFT component in the reflective mold liquid crystal display of the 1st operation gestalt concerning this invention.

[Drawing 4] Drawing 4 (a) - (e) is process drawing showing the manufacture approach of the reflective mold liquid crystal display of the 2nd operation gestalt concerning this invention.

[Drawing 5] Drawing showing an example of the cellular phone equipped with the liquid crystal display with which drawing 5 (a) was manufactured according to the above-mentioned operation gestalt, drawing showing an example of the pocket mold information processor equipped with the liquid crystal display with which drawing 5 (b) was manufactured according to the above-mentioned operation gestalt, and drawing 5 (c) are drawings showing an example of wrist watch mold electronic equipment equipped with the liquid crystal display manufactured according to the above-mentioned operation gestalt.

[Drawing 6] Drawing 6 is the outline block diagram showing the important section of a projector using the liquid crystal display manufactured according to the above-mentioned operation gestalt as light modulation equipment.

[Drawing 7] Drawing 7 is the outline sectional view showing the structure of the common liquid crystal display for direct viewing type liquid crystal displays.

[Drawing 8] Drawing 8 is the outline sectional view showing the structure of the common liquid crystal display for projection mold liquid crystal displays.

[Drawing 9] Drawing 9 is the outline sectional view showing the structure of the reflective mold liquid crystal display for projection mold liquid crystal displays.

[Drawing 10] Drawing 10 (a) and (b) are drawings explaining the problem of a curve of the substrate in the reflective mold liquid crystal display for projection mold liquid crystal displays.

[Description of Notations]

10 30 Liquid crystal display

11 31 Substrate

11A, 31A Monotonous member

12 32 Opposite substrate

13 Liquid Crystal Layer

14 Sealant

14A A non-hardened sealant

15 Pixel Electrode (Reflector)

16 Data Line

17 Common Electrode

18 19 Orientation film

20 MOSFET Component

22 Scanning Line

[Translation done.]

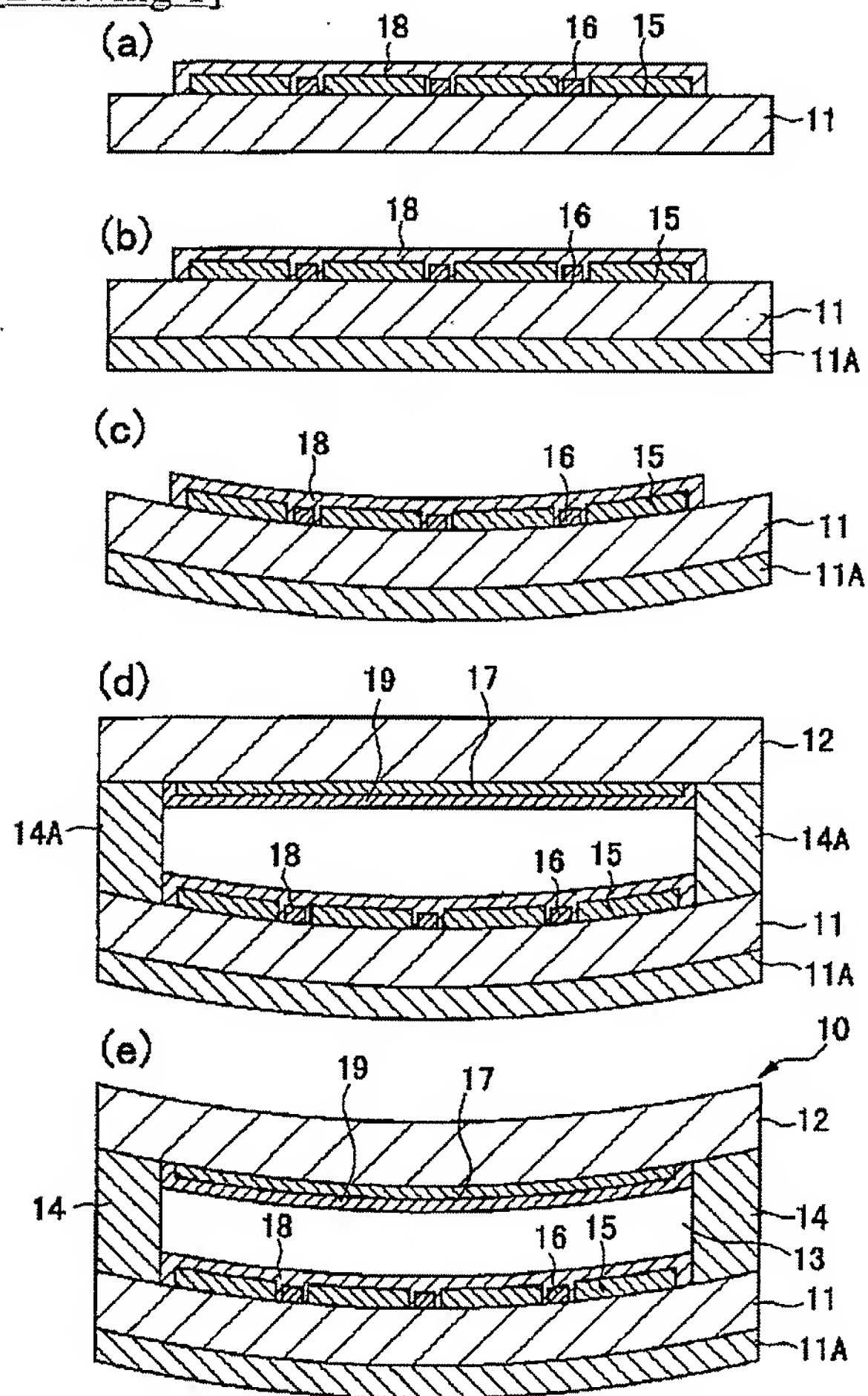
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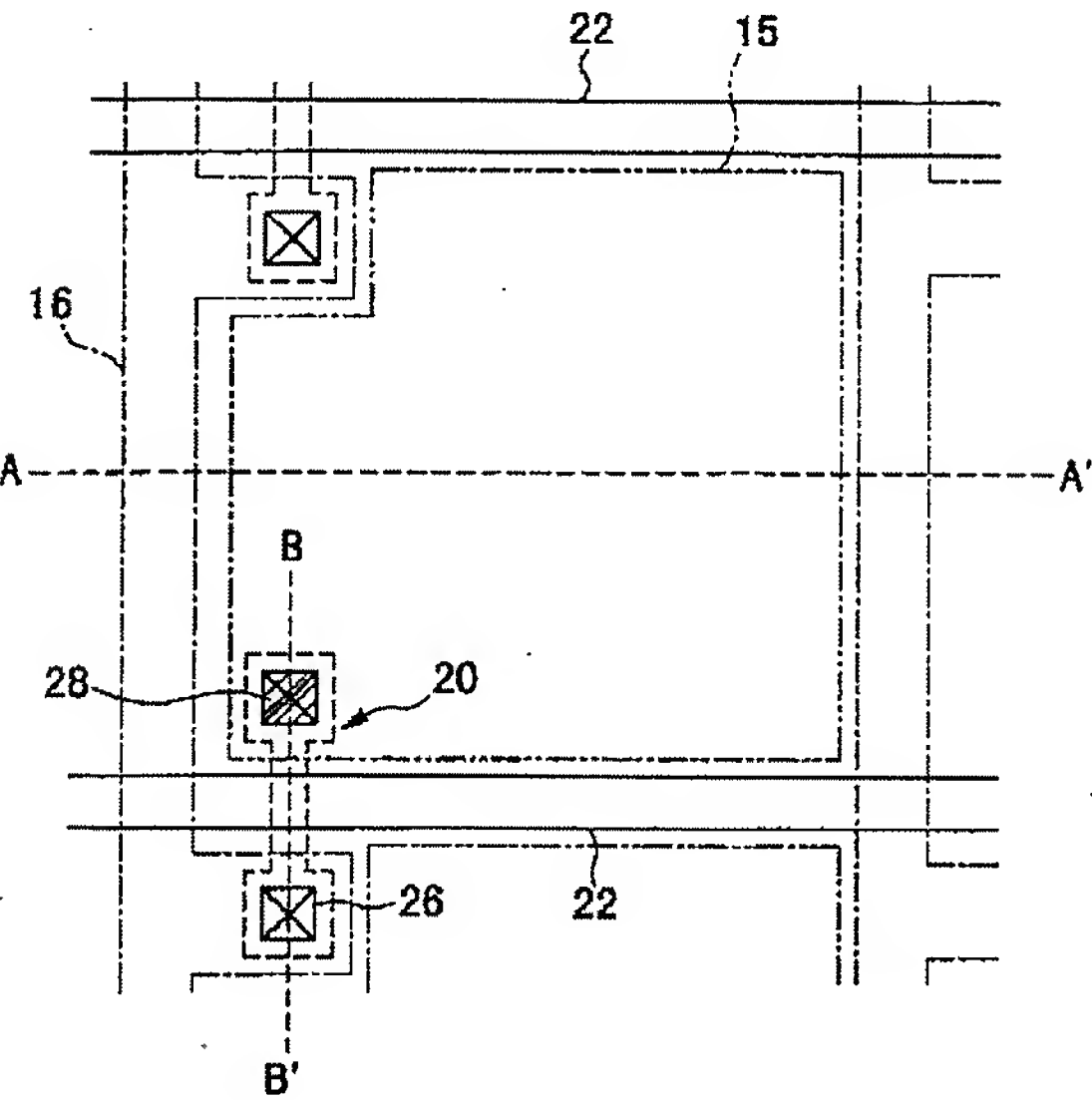
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DRAWINGS

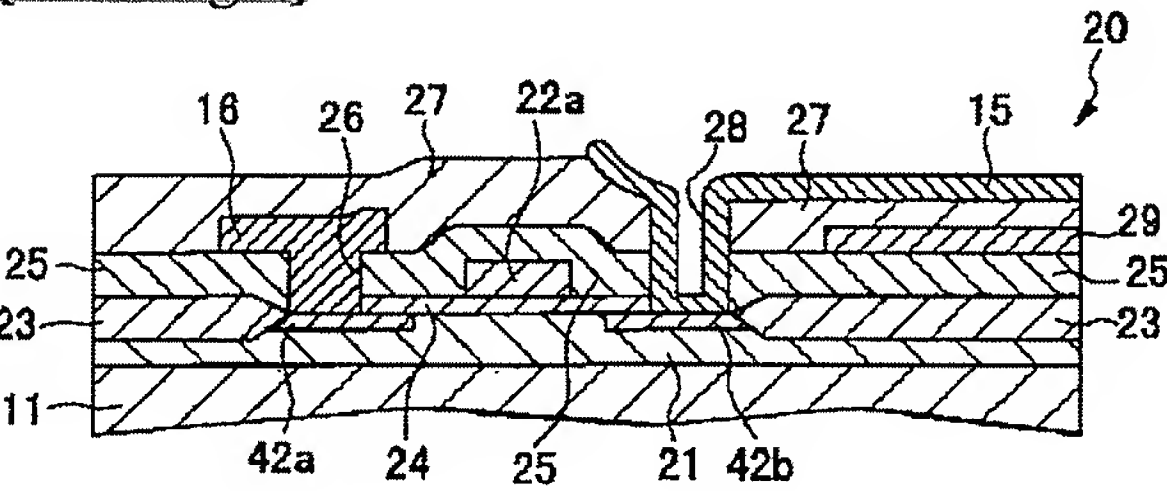
[Drawing 1]



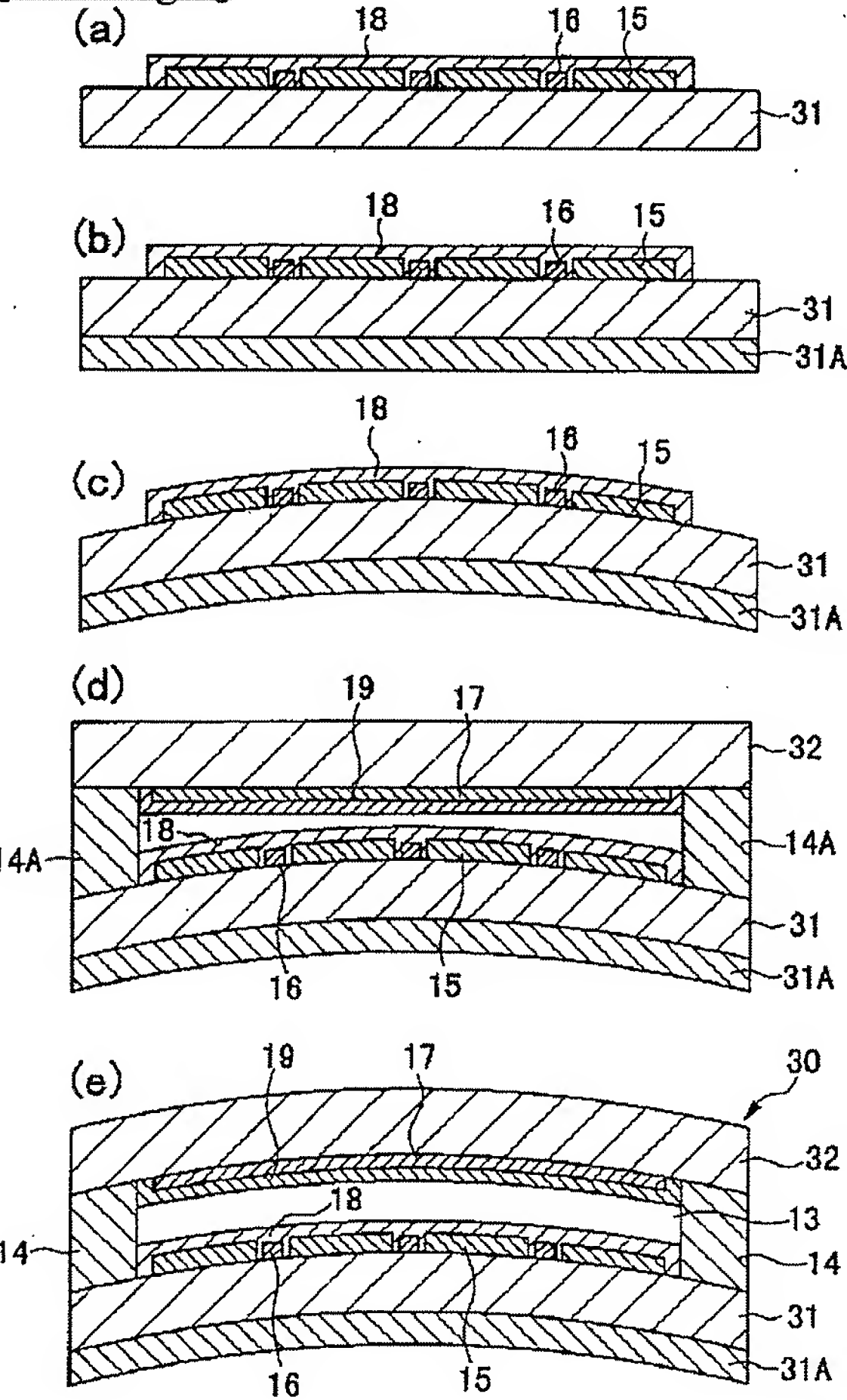
[Drawing 2]



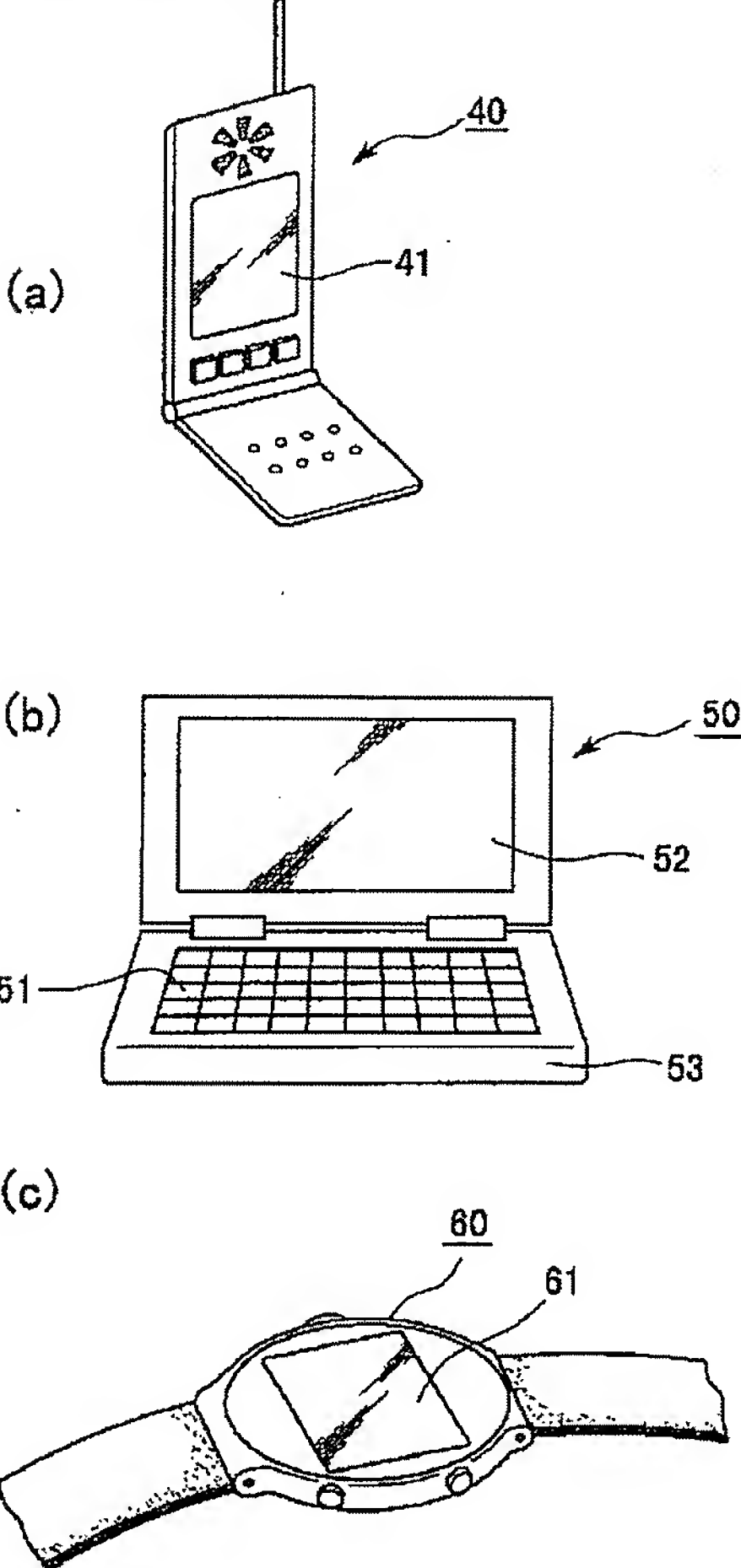
[Drawing 3]



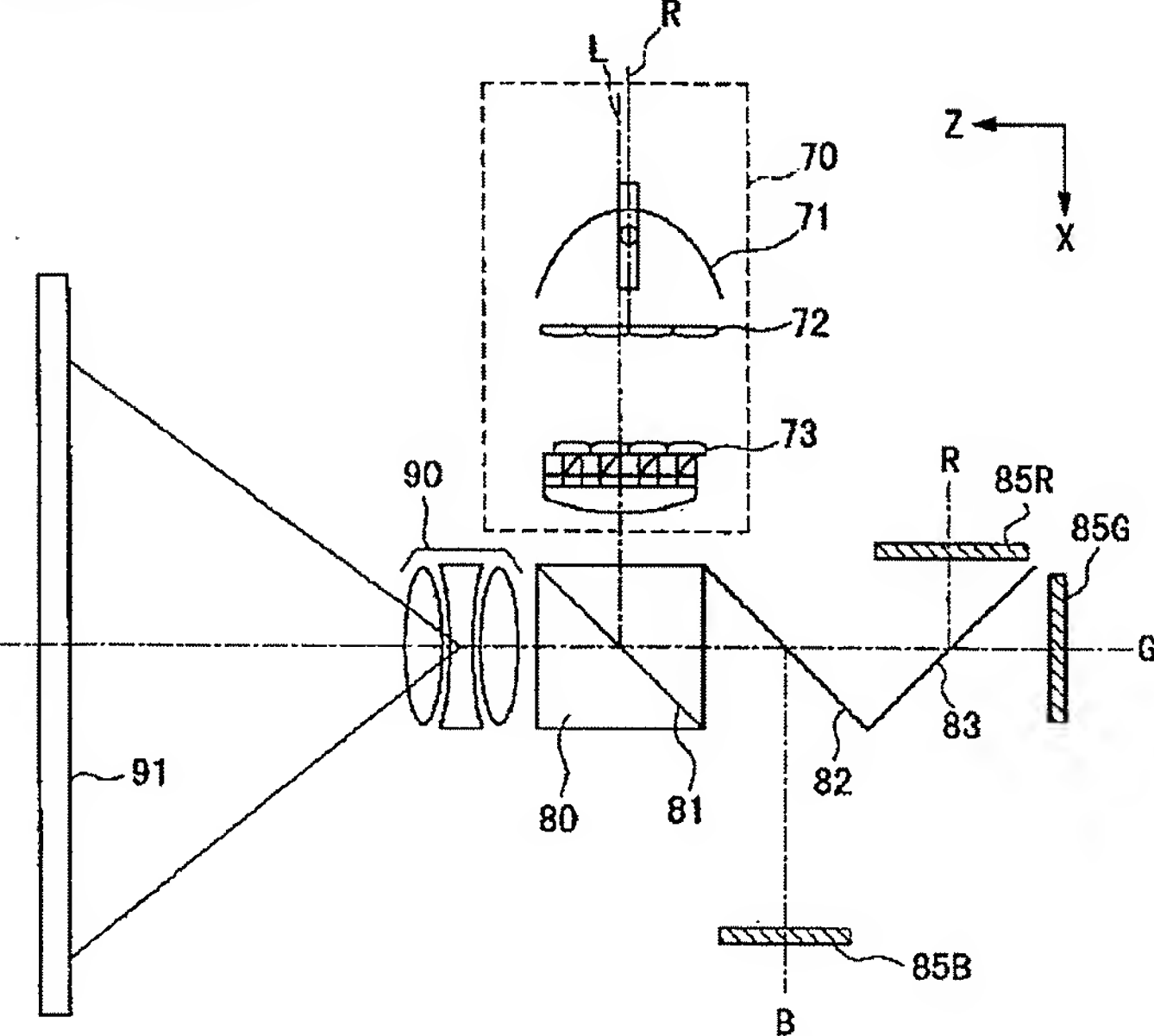
[Drawing 4]



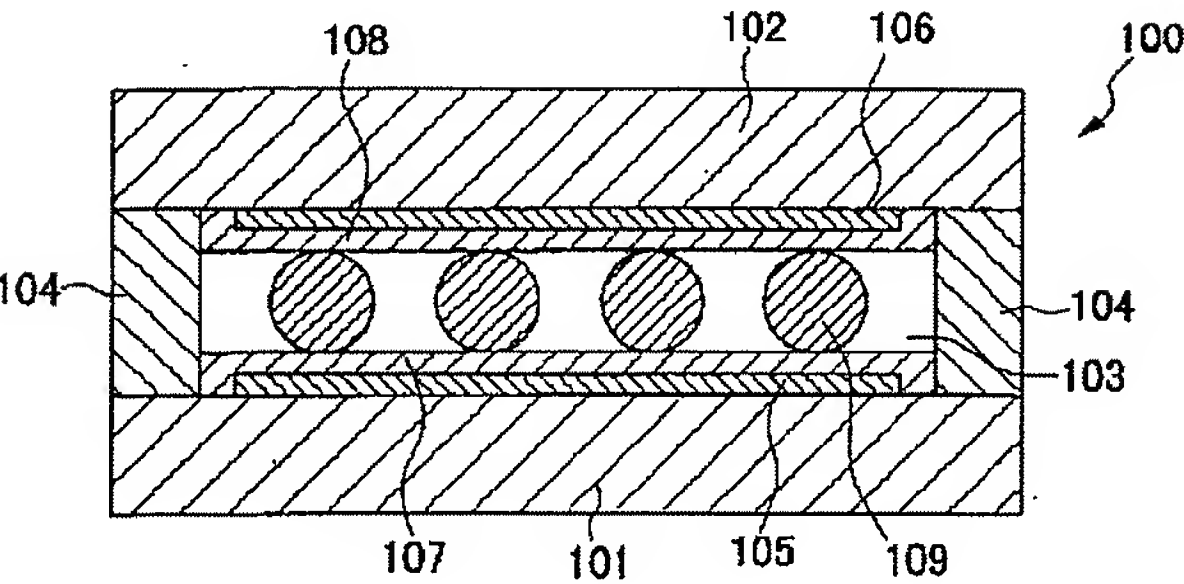
[Drawing 5]



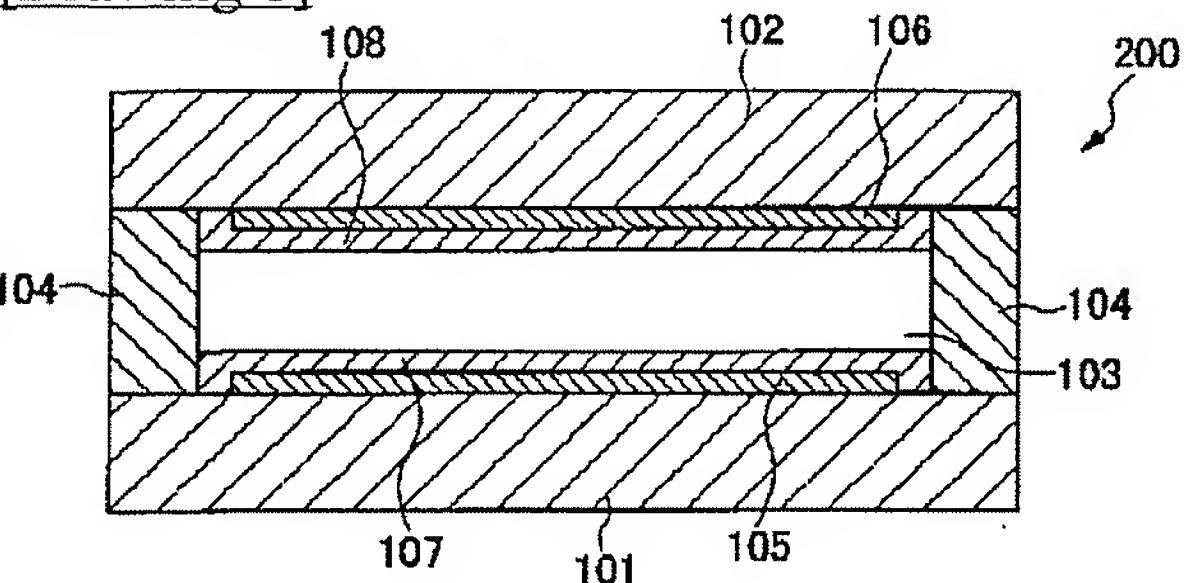
[Drawing 6]



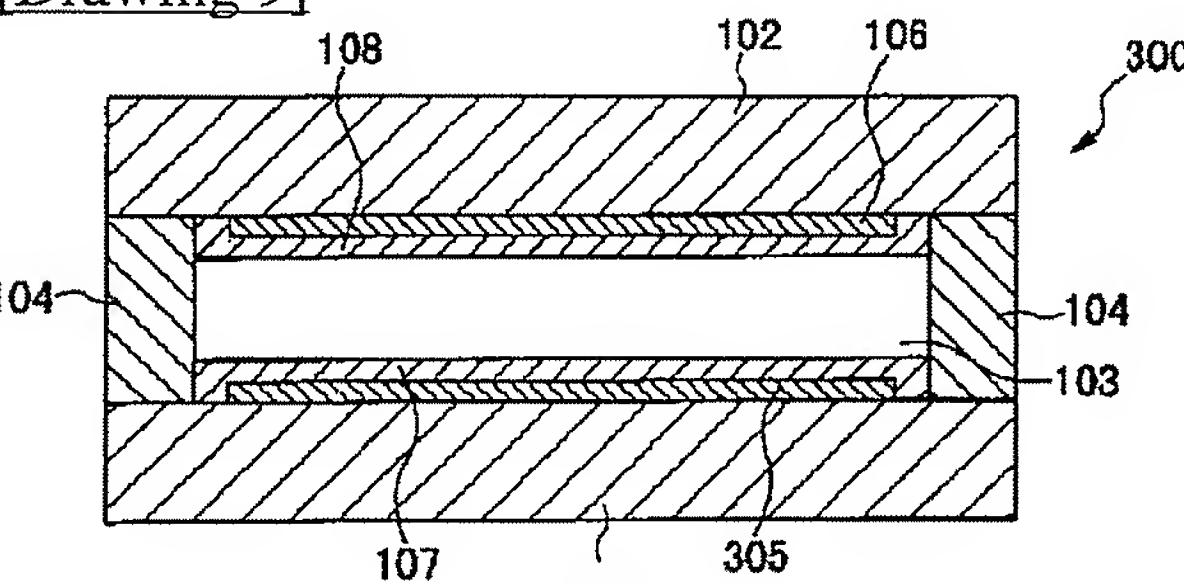
[Drawing 7]



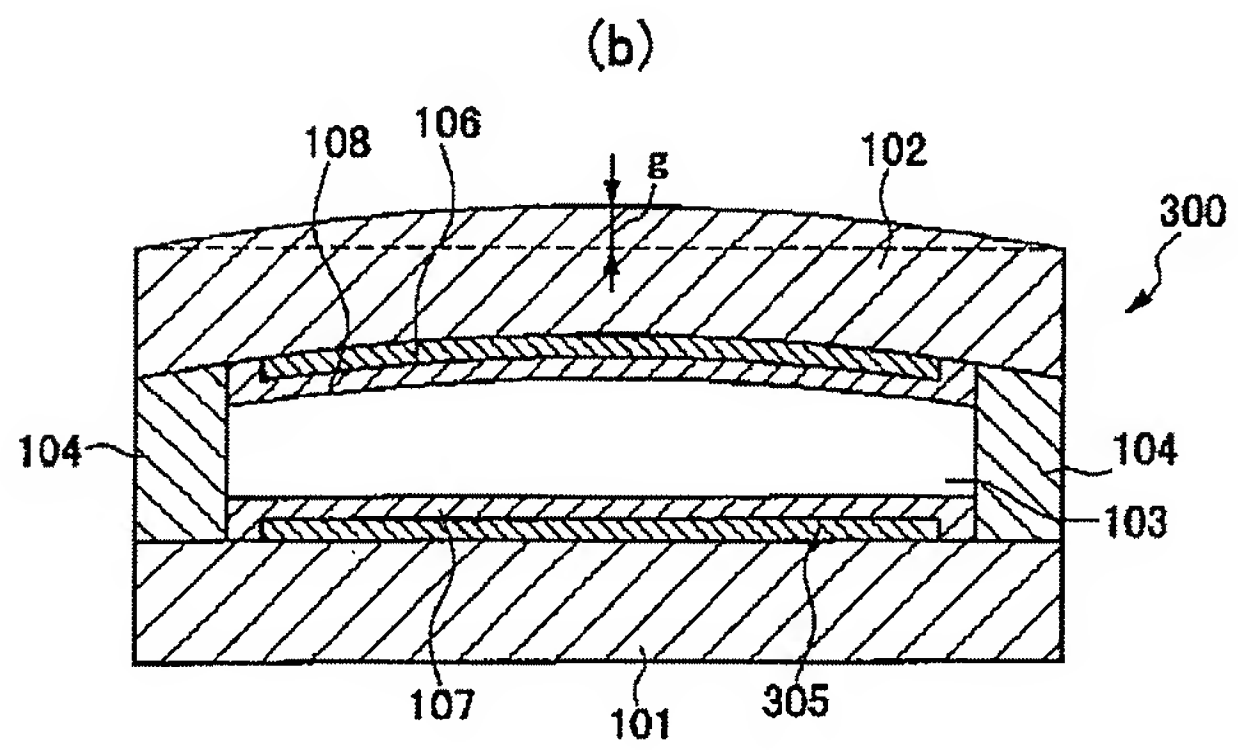
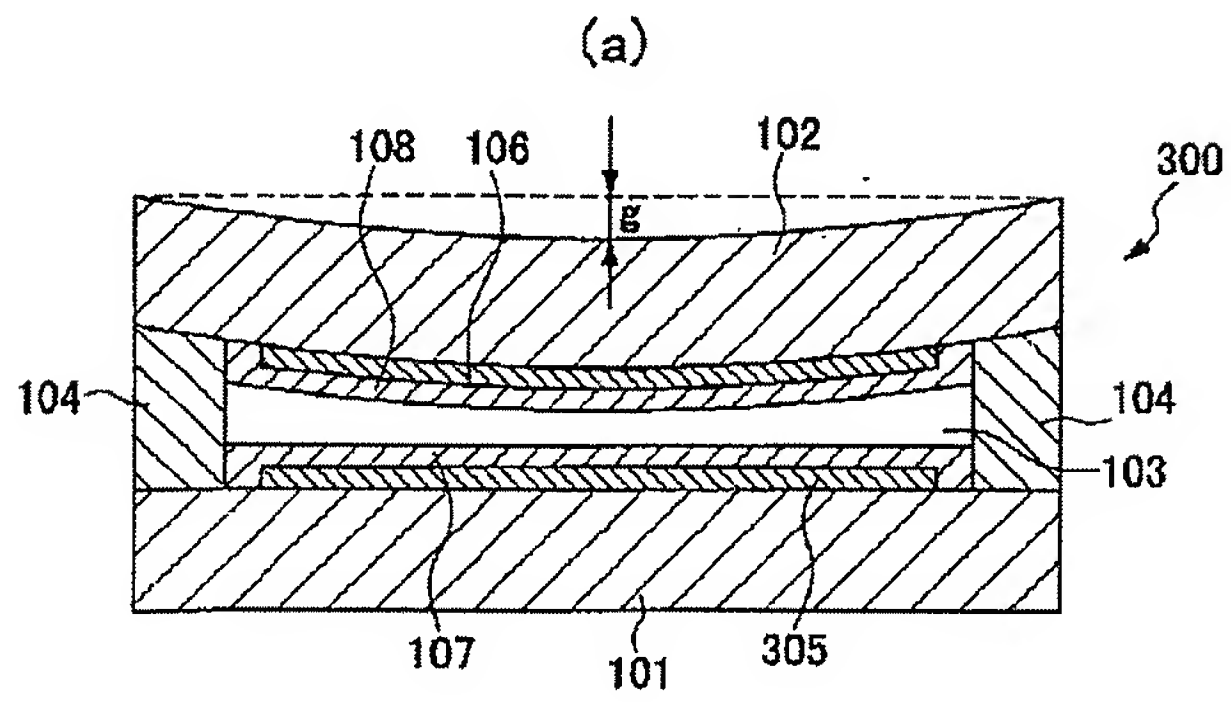
[Drawing 8]



[Drawing 9]



[Drawing 10]



[Translation done.]